TELEPHONE ENGINEER

VOLUME 27 MARCH, 1923 Number 3

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TELEPHONE ENGINEER, March, 1923, Volume 27, No. 3. Published monthly by TELEPHONE ENGINEER. Publication office, 28 E. Jackson Blvd., Chicago, Ill. Subscription price $2 a year in the U. S. Entered as second class matter June 6, 1922, at the Post office at Chicago, Ill., under act of March 3, 1879.

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VOLUME 27 MARCH, 1923 Number 3

Storm View of Birmingham-Tuscaloosa Toll Line Near Grasselli Station; No. 12 Copper Wire

Storm View, Birmingham Exchange, Cable Route on Phelan Street, Birmingham; 200-Pr. Cable

Sleet Lands K. O. on Dixie

Most Disastrous Ice Storm in 35 Years Romps Way Through Birmingham District — Repair Forces in Fight of Lives — Thousands of Wires in Trouble

By T. Barton Baird*

Birmingham, Ala. — On Monday morning, February 5, Birmingham and the entire southern portion of the Birmingham plant district, was under the weight of the heaviest sleet storm that has been experienced in this section of the country for more than 35 years.

The action of the sleet storm was first experienced on our property about 6:00 p. m. on February 4. At this time the temperature was 32, with a precipitation of .02, and a wind velocity of 23 miles from the northwest. From 2:00 o'clock on the morning of February 4 until 6:00 o'clock on the morning of February 5, the temperature hovered between 28 and 32, with a slow, drizzly rain falling. The accumulation of sleet on the wires caused by this peculiar weather condition amounted to approximately 1⅛ in. on a No. 12 gauge wire.

Our toll circuits through the district started to drop out on Sunday afternoon about 6:00 o'clock and we lost the last circuit to Atlanta at 4:00 a. m. on February 5. At this time there was one railroad wire over the Southern Railroad working to Atlanta. However, within a short time this circuit was also lost and upon investigation it was found that the Western Union Telegraph Co., the Postal Telegraph Co., all the railroad wires, all the wires of the A. T. & T. Company and the Southern Bell Co. were out of service.

The service of the local street car company was completely paralyzed and all cars were at a standstill, and service was only restored on a single line by Monday afternoon.

Wires of all kinds broke under the heavy weight of the frozen ice upon them or were torn down by the falling of ice-covered trees. The majority of the damage to the telephone property was caused by the heavily weighted ice-covered limbs falling down on our wires and cables. The greatest damage of the sleet storm was within a 50-mile area of the city, as no troubles were experienced in the northern end of Alabama near Sheffield, Albany and Huntsville, neither did we experience plant damage around Anniston or Sylacauga.

However, the sleet did extend as far south as Eutaw and considerable damage occurred in the Eutaw, Centerville, West Blocton and Tuscaloosa Exchanges, which are around 50 miles south of Birmingham.

We had some warning of the sleet storm being on its way, as we had advice from Sheffield, Huntsville and Albany that they were experiencing bad weather conditions. However, the temperature at these points dropped 25 degrees within a period of two hours' time which, of course, saved them from the sleet damage.

The bad weather came into the Birmingham district from the northwest

*Mr. Baird is district manager of the Southern Bell Telephone & Telegraph Co., at Birmingham, Ala. This article, written by request, tells a graphic story of the storm and its havoc.

and when it reached the peculiar location of the territory which is known as Jones Valley, which lies between two mountain ranges in Jefferson County, the temperature held at the critical point for such a great length of time that the glaze accumulated on the wires. While we had this certain warning, nothing could be done as we did not know just how the weather would terminate.

However, on Sunday afternoon, conconsiderable preparation was made in lining up forces for the restoration of service on Monday morning, if we did find considerable plant trouble.

With this arrangement of forces and finding ourselves completely isolated from the outer world as regards wire service, scouts with one man each were dispatched on all toll lines radiating out of Birmingham, Ala., Monday morning with instructions to get the situation and to report back the result of their observations. Following these men we sent other men with instructions to restore service on certain wires.

We also concentrated on the Nashville-Montgomery line south, as it was decided that this line would probably be the least affected south of Shades Mountain. This proved to be a fact as the sleet in this direction did not extend any farther south than Calera and we opened up one circuit through to Montgomery at 11:53 a. m. on the morning of February 5.

This was the first circuit restored to service by any wire-using company in Birmingham and it was made good by the combined efforts of the Southern Bell and American Companies' employees. Later on that day another circuit was opened up to Atlanta. That night, by intermittent service, we found that our plant men from Jasper, Gadsden, Tuscaloosa and Sylacauga, were working towards Birmingham to make other circuits good.

The work of restoring local service at this writing is still in progress on February 10, and our records show that we have had a total of 4,275 lines reported in trouble which could be attributed to the action of the sleet storm.

The power failed at midnight Sunday night in the West End, Bessemer, Ensley and Woodlawn Exchanges in Birmingham, this making a total power failure for our source of current for charging the storage batteries and the Delco engines in Ensley, were used for charging batteries until power service was restored in these two exchanges and portable Delcos were hurriedly transferred to the West End and Woodlawn Exchanges and kept continuously running until power service was restored on Wednesday afternoon. The power company's steam plant in the business section of Birmingham was steamed up by 10:00 o'clock Monday morning and power service resumed for charging the batteries in the Main Exchange.

A summarization of the pole plant damage covers a total of 550 poles broken down on local property and a total of 472 poles broken down on toll property and a total of 375 miles of toll wire to replace which was damaged by the sleet.

The illustrations are reproductions of photographs which were made at different locations over the Birmingham Exchange and show conclusively the action of the sleet storm on our plant throughout the city.

Anticipating the situation of Monday as regards the traffic organization, we began planning Sunday for the rush and operators were sent to local hotels Sunday night instead of to their homes, so that they might be ready for the extra rush Monday morning. Many operators who live four and five miles out of town walked to the office Monday morning in order to help out in the rush and it was found that many of them left their homes before daylight to reach their work on time. Many other operators were brought to their work with the aid of taxi-cabs and automobiles which were driven by plant employees.

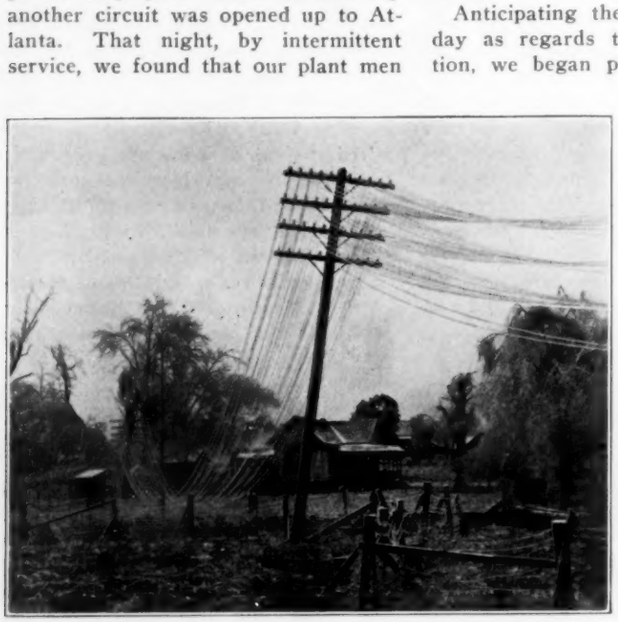
All available forces in the plant organization were made available for the repair work as quickly as possible and the old-time spirit of "service" was evidenced by all employees.

New York Is World's Greatest Telephone Center

With 1,100,000 telephones, New York City has one for every five persons. The New York Telephone Co. covers New York state, northern New Jersey and west Connecticut, and controls 1,800,000 telephones distributed among a population of 15,000,000. Bell System has 14,000,000 telephones, so the New York company operates approximately one-seventh of the entire system.

Telephones Are Hard to Get in Japan

A telephone is a luxury in Japan, to be obtained by long waiting or the payment of exorbitant prices. Brokers have established businesses all over the country to deal in telephones, buying those that customers no longer want, getting others from the government departments and selling them at high prices.



Birmingham-Tuscaloosa Toll Line Near Powderly Station; No. 12 Copper Wire

Birmingham-Sheffield Toll Route on Eighth Avenue, Birmingham; No. 12 Copper Wire

Cutting Construction Costs

There Are Many Ways in Which Proper Supervision May Cut New Plant Outlay—In This Article Some Constructive Criticism and Suggestion Are Offered

By R. V. Achatz

In spite of the increase in investment in telephone equipment which has come about by the introduction of machine switching, the outside plant portion of the telephone investment still amounts to considerably more than one half of the total.

This fact together with the scattered nature of the investment over the entire area served and the necessity of making changes and extensions in a more or less piecemeal fashion makes the problem of engineering and constructing the outside plant quite different from the engineering of the central office or of the other portions of inside plant.

In general the outside plant is engineered and constructed in smaller units introducing the difficulties of coordination of detail engineering with a general plan of development and difficulties of supervision of construction to see that miscellaneous changes are made in accordance with approved plans and that no unauthorized additions or changes are made.

Outside construction work is naturally a seasonal kind of work and the greatest activity begins in early spring after a period of almost complete standstill, at least in the northern states. The season of increased activity is now here and every telephone company is engaged in working out its own particular problems of construction.

In doing its work each company is naturally interested in improving conditions and a few thoughts offered in a spirit of constructive criticism may be of assistance to some. Most of what will be said will be of interest to the smaller and medium-sized exchanges but may apply to others as well.

Separate Planning from Performance

One of the outstanding features of a very large number of telephone exchanges is the apparent lack of any definite plan of doing things. The principle of management which would separate the planning of work from the performance of work seems never to have been heard of, even in companies of sufficiently large size to make such separation very easy.

Where the system is of sufficient size that the planning may be put into the hands of one man with assistants if necessary and the performance placed in charge of another man both reporting to an executive head, the conditions are most favorable.

There seems to be no valid reason, however, why the planning and performance can not be separated to some extent even in the smaller companies where the same man may have to do all of one and a portion of the other.

The separation can be one of time. The same individual may make plans in advance and then look after the performance of work in accordance with his plan. Too often the planning is started after the material is delivered on the job. The plant is then much in the same condition as a certain machine which was described as "built first and designed later."

Practice in Purchasing May Be Improved

Another opportunity for improvement is usually offered in the purchasing of material particularly in case of the companies which purchase in the open market. Not all companies can afford a purchasing agent as a special official but every company can concentrate the function of purchasing in the hands of one individual. Here are possibilities of material saving if a little study is given to conditions.

Planning of requirements over a period may result in ability to purchase in quantity and obtain the advantages of quantity discounts. Study of markets and deliveries may result not only in saving of money by buying in a favorable market but may save time and loss by having the material on the job when it is needed.

Purchase of material in less than standard packages should be avoided whenever possible and the use of special material of all kinds should be discouraged.

Poor Storage Facilities as a Source of Loss

When work is planned in advance and material is ordered, it becomes necessary to provide storage until the material can be put into the plant. Many telephone companies have poor or almost no storage facilities. We have all seen fine new poles lying on the ground instead of being piled on skids. We have seen wire, cross arms, pole line hardware and even more perishable material stored in the open or under leaky shed roofs.

We have seen stock rooms in such a jumble that no one on earth could determine the stock of any particular class of material on hand. The remedy for this condition of poor storage is a little expenditure for proper storehouse facilities and a little time and care in arranging stocks. An orderly habit of mind on the part of those who handle materials is one of the greatest helps.

Transportation as Factor

A factor of some importance in the cost of construction is the matter of transportation of both materials and men.

Practically all companies have adopted the automotive vehicle as a means of transportation realizing that the saving in time more than offsets the increase in cost per mile traveled. Yet many companies will permit the loss of much valuable time through vehicle failures on the job.

The loss of an hour of time for a gang of five or six men due to engine or other trouble along the road makes it rather an expensive matter to allow the engine or the truck to get into condition that trouble occurs. A saving in maintenance of automobile or truck is pretty sure to prove very expensive in the long run.

Another matter which may be considered is the best utilization of the automotive equipment. A heavy truck may be sent out onto the job and remain idle the greater part of the day. A little planning might permit its being used in other places after it had delivered the men and material or it might be fitted with a power winch and be used in performance of much work on certain kinds of jobs instead of being allowed to stand idly by at the side of the road.

Other Matters Also Count

Time and space do not permit a discussion of many other matters that might be suggested. Proper number of men in gangs for various types of work, proper routing of work so that traveling is reduced to a minimum, proper equipment of tools so that the work can be done effectively and safely and other like matters might be given extended discussion. These matters are merely suggested as some of the things to which thought may be given by those in charge of construction programs to the benefit of themselves and their work.

Wisconsin Telephone Co. Will Spend $30,000,000

W. R. McGovern, president, says the Wisconsin company, plans to spend about $30,000,000 for new construction and additional equipment in that state in the next five years. Some of the larger cities and their share in the program follow: Appleton, $300,000; Ashland, $50,000; Baraboo, $21,000; Beaver Dam, $100,000; Beloit, $250,000; Chippewa Falls, $200,000; Delavan, $40,000; Eau Claire, $900,000; Fond du Lac, $200,000; Green Bay, $350,000; Janesville, $100,000; Jefferson, $35,000; Kenosha, $500,000; Madison, $650,000; Manitowoc, $60,000; Marinette, $90,000; Merrill, $50,000; Neenah-Menasha, $50,000; New London, $46,000; Oconomowoc, $40,000; Oshkosh, $130,000; Racine, $250,000; Shawano, $40,000; Stevens Point, $300,000; Stoughton, $35,000; Superior, $100,000; Waukesha, $200,000, and Watertown, $90,000. None of this includes routine work or toll line expenditures. Among the larger items in this work are 750,000 miles of telephone wire, 17,000 poles and 300 miles of conduit. During 1922 the company spent about $4,000,000 for new construction in Wisconsin and gained more than 8,000 new telephone stations. The company now operates 224,000 telephones in the state. The number of calls handled each day exceeds 1,000,000.

San Diego Phone Improvements to Cost $500,000

San Diego, Cal.—A. E. Scott, manager for the Pacific Telephone & Telegraph Co. in San Diego, has announced plans of development and improvement for the company in 1923 which will cost about $500,000. The rapid growth of San Diego has made much extension work imperative. The company placed 3,951 miles of wire last year and spent $65,500 on outside plant construction alone.

Will Spend $6,000,000 in New Orleans in Five Years

New Orleans, La.—The Cumberland Telephone & Telegraph Co. plans to spend $6,000,000 in New Orleans in the next five years for improvements, according to John C. Hay, district manager. The schedule for 1923 calls for an outlay of $1,236,000. It is estimated that there will be a net gain in 'phones of approximately 4,000 this year.

Five-Year Building Campaign Calls for $250,000,000

New York, N. Y.—The New York Telephone Co., in a letter to the public service commission, has said that the company has a construction program which calls for an expenditure of $250,000,000 in the next five years. H. F. Thurber, president, said that new plants in New York City last year cost $45,500,000. He put the cost requirements for 1923 at $55,000,000.

Los Angeles Company Plans to Spend $14,000,000

Los Angeles, Cal.—The Southern California Telephone Co. is planning an expenditure of $14,000,000 this year as compared with $13,500,000 last year for construction work. There are now in Los Angeles 190,000 telephones or 57,000 more than in 1918. Of this number 27,000 were added last year. The company expects to have 250,000 subscribers by 1928.

Work Being Pushed on New Boston-Chicago Cable

Akron, O.—Work on the new Boston-Chicago cable of the American Telephone & Telegraph Co. is being pushed in spite of winter weather and should be completed as far as Cuyahoga Falls by about May 1. It is being built at a cost of about $200,000 a mile. A fleet of twenty trucks and 100 picked splicers are operating.

Extensions at Nashville Call for $90,000 Outlay

Nashville, Tenn.—The Cumberland Telephone & Telegraph Co. plans to extend its lines this year at a cost of $90,000. The extensions planned would mean an addition of about 750 telephones in service.

Ashtabula, O., To Spend $100,000 On Plant Expansion

Ashtabula, O. — The Ashtabula Telephone Co. is planning to spend $100,000 this year in plant expansion.

FIELD REPORTS SENT IN BY OUR CORRESPONDENTS

Notasulga (Ala.) Telephone Co. will give its lines a general overhauling.

Hardy (Ark.) Telephone Co. will build 15 miles of rural lines to accommodate new subscribers. and is wanting 15 telephones.

Ripon (Cal.) Telephone Exch. will install Leich Automaphones, says owner G. F. Green.

Sunland (Cal.) Rural Telephone Co. will double its wire plant.

South Atlantic T. & T. Co., Miami, Fla., will make inside and outside plant additions to the extent of $500,000. F. W. Webster is general manager and W. A. Jamieson plant chief.

Crescent City (Fla.) Telephone Co. intends to make only the ordinary repairs this season. Arthur J. Walker is engineer for the plant.

Wilder (Ida.) Telephone Co. reports a general expansion program planned. This formerly was the Weston Telephone Co. F. M. Saunders is manager.

Dubois County Telephone Co., John J. Himsel of Jasper, Ind., manager, is in the market for poles. This company also operates exchanges at Birdseye, Dubois, Ferdinand, Haysville and Ireland.

Mexico (Ind.) Home Telephone Co. will replace some of its old wire with new this summer. J. S. Bair is manager.

Odon (Ind.) and Madison Township Telephone Co. plans for general rebuilding. R. J. McCallian is secretary-treasurer.

St. Meinrod (Ind.) Telephone & Telegraph Co. wishes quotations on 100 transmitters and receivers and a 100-line switchboard. E. R. Cooper is owner and manager.

Clarence (Ia.) Telephone Co. will build some new cable lines and is in the market for cable and miscellaneous supplies.

Farmers Mutual Telephone Co., Center Junction, Ia., will build 10 miles of wire, and will want BB No. 12 wire, brackets and insulators. J. L. Serbousek is manager.

Oxford Junction (Ia.) Telephone Co. will install underground cable and is in the market for 3,000 feet of same. A. E. Hodoval is president and manager.

Central Mutual Telephone Co., Rockwell City, Ia., plans to rebuild its aerial lines this season. Perry Holdoegel is manager and E. E. Cooper plant superintendent.

Tracy (Ia.) Telephone Co. is in the market for poles. W. G. Maddy is president.

United Telephone Co., of Abilene, Kans., plans a lot of new building

including underground cables and a common battery switchboard.

Watertown (Minn.) Telephone Co. reports it is in need of general telephone supplies.

Farmers & Merchants Telephone Co., Odessa, Mo., will install a new switchboard. A. L. Cooper is manager.

North Mutual Telephone Co., Gentry, Mo., will build several new pole lines.

Chester (Neb.) Telephone Co. plans considerable new cable work. E. L. Brown, secretary-manager.

West Jersey Toll Line Co., Belvidere, N. J., will rebuild its lines along the state highways. J. F. Burley, superintendent and manager.

Richmondville, Seward & Sharon Telephone Co., Richmondville, N. Y., will rebuild a part of its plant and install additional office fixtures.

Independent Telephone Co., Zap, N. D., will install a new switchboard. R. K. Hafner is owner.

North Lewisburg (O.) Telephone Co. plans various improvements for this season. L. E. Willis is manager.

L. R. Woolf, Stroud, Okla., reports that he will erect a new office building.

Talala (Okla.) Telephone Co. will erect six miles of wire and install ten new telephones. Harry L. Gifford, manager, is in the market for the 'phones and 1,000 lbs. of wire.

Farmers Rural Telephone Co., Woodward, Okla., R. D. 5, will build a new line to Selma. Ira J. Fields, secretary-treasurer.

Maxville Telephone Co., Logan, O., R. D. 7, Box 87, will install some new 'phones. Leonard Bell is president.

J. L. Sloan, Stryker, O., reports that his company plans considerable repair work this summer.

Interurban Telephone Co., Silverton, Ore., will install about 2,000 ft. of cable. Several rural lines are planned. P. L. Brown is manager.

Beechwoods Telephone Co., Falls Creek, Pa., R. D. 1, will make some repairs and is wanting 1,000 lbs. of galvanized wire, 25 crossarms, 200 brackets and 100 pins. J. P. Smith is secretary and purchasing agent.

J. H. Snyder, of Lavelle, Pa., reports that his company will build a line from Gordon to Ashland, Pa., this summer.

New Alexandria (Pa.) Telephone Co. estimates that it will do about 12 miles of renewal work this year. It would like prices on 200 ft. of 50-pr cable, one ton of No. 12 copper wire, one ton of No. 14 copper wire and 1,000 lbs of No. 12 iron wire. John C. Giffen is secretary-manager.

Lumber City (Pa.) Rural Telephone Co. will erect five miles of copper wire. D. B. Hiles is secretary-treasurer.

Farmers Telephone Co., Shickshinny, Pa., is in need of cable and copper wire for May 1st delivery. Address E. Dana Sutliff, secretary.

Raleigh Telephone Co., Frost, Tex., will want 1,000 pounds of new wire in April to take care of the new work which Manager Fred Turner has planned.

Medical Lake (Wash.) Telephone Co. wants selective lock-out telephones. J. F. Goldback is manager.

Peoples Telephone Co., Rio, Wis., will use 500 poles, 150 miles of wire and the necessary complement of supplies. Address J. L. Farrington, manager.

McLean Telephone Co., McLean, Tex., will need poles and cable for some work it will do this summer. John Kibler is proprietor.

Lewisville (Ind.) Telephone Co. plans general reconstruction for the present season. Wire, poles, cross arms, pins, brackets, insulators and telephones are wanted. Frank Lindsay is manager and V. O. Chance, secretary and treasurer. Address the latter regarding supplies.

Farmers Telephone Co., Point Marion, Pa., will erect new polls, string new wire and install 25 new phones. It is in the market now for these articles. E. J. Moore is manager.

Nansen Telephone Co., Howard, S. D., will build about forty miles of rural lines this year. R. F. Frederiksen is manager.

Dakota Central Telephone Co., Aberdeen, S. D., will build this summer 12 miles of farm lines and 41 miles of toll lines.

Carpenter (S. D.) Telephone Co., E. H. Baker, manager, will erect 12 miles of new line, and is in the market for the necessary poles, wire and telephones.

Mitchell Telephone Co., Sebring, Fla., will build toll lines south to connect with the East Coast of Florida. W. B. Mitchell is general manager.

Farm and Home Telephone Co., Wagner, S. D., has about 20 miles of new lines to build this summer and wants quotations on the poles and wires that will be needed. Abbott Little is manager.

Castro Telephone Co., Dimmitt, Tex., will build 100 miles of new line and install 25 or more additional telephones. C. H. Buttolph is owner.

Vaughan Telephone Exchange, R. F. 7, Hillsboro, Tex., will overhaul and repair all its lines and instruments this season. L. F. Shoemaker is owner and manager.

Chilton (Tex.) & Mooreville Telephone Co. is in the market for poles, wire, cross arms, insulators, bolts, guy strand, cable and other supplies needed for this year's maintenance and construction work. H. H. Little, Chilton, is manager.

Michigan State Telephone Co., Petoskey (Mich.) Exchange, will have considerable cable extension work this season and a lot of new building. H. J. Johnston is commercial manager at Petoskey and F. D. Nelson district wire chief.

Lake Shore Telephone Co., Little Marais, Minn., will do some cable work this season and is in the market for cable and drop wire.

J. S. Hanna, manager of the Southwestern Bell Telephone Co. at Galveston, Tex., will install pre-payment pay stations this year.

Warren (Mich.) Rural Telephone Co. will erect four and one-half miles of cable this summer. F. A. Wartlow is manager.

Farmers' Two River Telephone Co., Lancaster, Minn., will build a 20-mile extension and is in the market for cabinets, poles, wire and general equipment. Mike Ekstrom is manager.

Black River Telephone Co., Lowville, N. Y., is installing a new $20,000 Kellogg switchboard.

People's Home Telephone Co., Maryville, Mo., plans to soon have a home of its own.

Bureau County Independent Telephone Co., Dixon, Ill., is selling stock locally to raise funds for plant additions and new toll lines.

American Tele. & Teleg. Co. will start soon on an aerial cable toll line from Chicago to South Bend. Later similar lines will be built to Toledo and Cleveland, giving a line from the Eastern Coast to Chicago and Milwaukee. The Chicago-South Bend cable involved an exceptionally close choice between the relative merits of aerial and underground construction. From the many conflicting considerations, some favoring aerial cable and some underground, a decision favoring aerial cable finally was reached.

Southwestern, of Missouri, to Redeem $25,000,000 Issue

St. Louis, Mo.—The entire issue of $25,000,000 Southwestern Bell Telephone Co., of Missouri, seven per cent convertible notes, due April 1, 1925, are to be redeemed April 1, 1923, at 102 and interest.

Bell Annual Report

The annual report of the Bell System has just been made public. Following the practice in previous reports, a complete survey of the business of the American Telephone and Telegraph and associated companies during the year is given. The report points out the telephone situation in this country as compared with other portions of the world. Its immense area, single language and the widespread nature of family, social and commercial interests make any telephone service which is not co-extensive with the national boundaries unsatisfactory. It is pointed out that more has been spent in providing additional facilities in the past three and one-half years than in the ten years preceding the war. It is necessary to get and retain the good will and respect of the public as well as to provide the necessary plant, and the activities of the Bell organization in this respect are described.

In the report of financial results, some of the outstanding facts are that the associated companies earned but 5.6 per cent on the book cost of their plant, while the net earnings of the American Telephone and Telegraph Company was 11.14 on the average outstanding capital stock. This condition is due to the fact that a portion of the earnings have been consistently reinvested in plant and over $40,000,000 in excess of par has been paid in cash for the stock outstanding. The equity of the stockholders in the business now equals approximately $190 per share.

New financing during the past two years has been principally through the issue of stock rather than through the issue of bonds and notes. In 1920, the funded debt amounted to over 50 per cent of total capital obligations and in 1922 it had been reduced to a little over 40 per cent, the net decrease in funded debt being $22,600,000.

During the year, a policy of placing preferred stock of associated companies in the hands of the public resulted in the sale of 451,656 shares to 151,510 purchasers. In case of three out of four issues, the total amount was oversubscribed, the total applications being for more than twice the amount offered.

In matters of rate regulation, in the majority of cases, the rates have been fixed by commissions at a level that has been considered fair but in a few cases appeals have been taken to and the companies have been almost uniformly successful in their litigation. Progress has been made in clarification of some of the fundamental questions and in sound construction of regulatory laws.

The Development and Research branches of the company have been active during the past year, particularly in the use of cable. Improvements in the past year make it possible, now, to hold conversation through 3,000 miles of cable. Studies of radio telephony have been continued and the most important result has been the two-hour test of trans-Atlantic telephony on the night of January 14-15, 1923. At the present time it seems that the question of the real value of radio telephony depends more upon commercial than scientific and technical conditions. Until interference is eliminated by adequate control it will not have much commercial value.

In the field of operations, great progress has been made. A total of 586,000 stations were added during the year, which is the largest number ever added in a single year. Over 93 per cent of the exchange plant is in cable and 74 per cent of the cable is underground; 2,100 miles of long distance cables are now in service.

Machine switching is being introduced in the large centers in accordance with the plans previously formulated. Production, per employee, has been higher than previously and the labor turn-over is half what it was two years ago. The representation plan of the company for its employees is given credit for establishing a better acquaintance and more sympathetic understanding between the management and the employees.

During the year, the highest award from the Theodore N. Vail Memorial fund was made to Byron Ernest Thady, of Pueblo, Col., for services during the flood of June 3, 1921. Nine silver and one hundred and forty-four bronze medals were awarded; 563 employees were on the pension roll of the company on Dec. 31, 1922, and 32,185 employees received sickness benefits from the Employees Benefit Fund. Accidents involving loss of one day or more were reduced 15 per cent. Under the employees' stock plans, over 94,000 employees are now paying for stock.

The business of the Western Electric Company during the year amounted to $210,000,000, of which about three-fourths was sales to the Bell Companies. A tract of land has been acquired at Kearny, N. J., where an auxiliary manufacturing plant is proposed. The A. T. & T. Co. alone, after meeting all operating charges and making adequate provisions for depreciation and obsolescence, and for Federal and all other taxes chargeable against 1922 earnings, had available for interest and dividends $81,668,440. Interest charges were $15,498,011.88, a reduction of $4,023,097.17 from 1921, thus reflecting the reduction of $74,095,100 in the company's debt during the year. Dividends paid to stockholders at the rate of $9 per share per year amounted to $52,971,251.93, an increase of $10,296,848.93 over 1921, this increase being principally the result of an increase in the outstanding capital stock of $151,162,100. Of the resulting balance, there was appropriated for contingencies $5,000,000 and the remainder, $8,199,176.19, was carried to surplus. The present authorized share capital of the company is $750,000,000, of which amount $699,347,400 was outstanding at the end of the year. The directors recommend the authorized share capital be increased to $1,000,000,000, to take care of present commitments and future requirements, but they announced that no new stock offering is contemplated for 1923.

U. S. Bureau Studying Impurities in Batteries

The Bureau of Standards of the Department of Commerce has now undertaken a series of tests to determine the effect of various impurities in storage battery electrolysis and the relation between the amount of the impurity present and the extent of the damage done by its presence. The first of these, having to do with the effect of local action, has now been completed and the results published. Persons interested should write to the Superintendent of Documents, Government Printing Office, Washington, D. C., for Technologic Paper No. 225 of the Bureau of Standards, entitled "A New Method of Determining the Rate of Sulphation of Storage Battery Plate," copies being 5 cents each.

New England T. & T. Shows Good Business Increase

Boston, Mass. — The New England Telephone & Telegraph Co., in its report, shows that its operating revenues for 1922 totaled $41,437,407 as against $36,702,500 in 1921. Surplus after dividends and other charges was $870,720 as compared to $22,524 in 1921.

Buried Cable Trouble Study

Telephone Manager Collects Data for His Own Information and Presents It for Use of Others—Some Conditions That May Cause Trouble—Data on Lines

By Stephen M. Isom

Several years ago the writer heard about installing cable underground without the use of conduit. Later on he became interested from the standpoint of possible use in his own plant. Not being satisfied with the limited information available he began to write to those who were in a position to give the information regarding such installations.

At first a few personal letters were sent out to telephone companies who might furnish data but the letters received in reply were few and contained little definite information. After some consideration a new effort was made and the results were quite successful. Letters were written to several hundred telephone companies in all parts of the United States and Canada. In each of these letters detailed information was asked from the companies.

How did they proceed to install their cable underground without conduit? Was any protection used over the cable? What cable sizes were used? What was the number of feet installed? Where were terminal poles placed? What mechanical protection was used where the cable runs up the terminal pole? Were cable cans protected or unprotected? Was distribution made by open wire or twisted pair? What trouble has been experienced? How was it located? Are there water, gas, sewer, electric light or electric railway systems? Is this method of construction satisfactory?

Cable Without Conduit Widely Used

The number of replies received was much greater than was expected, over eighty percent of the letters being answered. In some cases it was necessary to write several times to individual companies concerning details of happenings since this manner of construction was adopted. The results of the canvass showed that underground cable without conduit is installed in twenty-eight of the forty-eight states of the Union and in one province in Canada. The following states were represented:

Alabama, Arizona, Arkansas, California, Florida, Georgia, Illinois, Indiana, Iowa, Idaho, Kansas, Kentucky, Missouri, Michigan, Minnesota, North Carolina, North Dakota, Nebraska, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Virginia, Washington and Wisconsin. The Canadian province was Ontario.

The data accumulated covered a total of 174.22 miles of telephone cable which had been in service for periods ranging from one to eighteen years. In general No. 19 B&S ga. with pure lead sheath was used in rural districts while No. 22 B&S ga. was used inside of corporate limits. The cable sizes ranging from five to four hundred pairs were in use.

The communities represented included towns from 600 to 51,000 population. Ninety-five percent of them have either water, gas or sewer systems; eighty percent have water or gas systems; seventy-one percent have water and gas or water and sewer systems. A large percentage have all three systems, water, sewer and gas. Ninety-eight percent have a.c. or d.c. electric light and power plants and more than fifty percent have transmission lines varying 5,000 volts or over. Approximately twenty percent have electric street or interurban railways in operation.

While the results of the study are necessarily incomplete as far as the writer is aware there has not been published information of a detailed character on anywhere nearly as large an amount of cable and it is thought that it will be of value to telephone men to present a summary of the experience of their fellows. For convenience the cable has been grouped in accordance with the length of time it has been in service.

Some Trouble in Cable One to Two Years Old

Information obtained from ten states for 34.44 miles of cable from one to two years old showed the sizes used to be from 10 to 300 pairs. Cables were installed from 18 to 36 inches deep in alleys, streets and country roads. 20.09 miles were installed without protection of any kind. In six cases rats had eaten off the sheath along elevators or corn cribs. In one case along stockyards several feet of sheath were eaten off by chemical action.

One case of trouble came in filled-in earth where the sheath was corroded and eaten full of holes for twenty feet presumably due to chemical action. 14.25 miles of cable had been protected by one or another of various methods of protection. In one instance the cable was covered with sand and concrete laid over the sand. In a few cases tar paper and concrete was used and in one case brick was laid along side and over the top of the cable.

One-inch boards of different widths were used in many cases. At the end of two years, examinations showed that the boards were almost entirely decayed. In a few cases the sheath was eaten off under the boards presumably by chemical action. There was one case of electrolysis and six cases where workmen digging for water or gas mains cut through all protection into the cable. In two cases of trouble, cable sheath was almost gone along toilets and manure piles. There was no trouble from electric storms.

Electrolysis and Workmen Cause Trouble

Results on cable that had been in service for a period of three to four years covered a total of 44.38 miles of cable ranging in size from 10 to 350 pair and located in eleven states and Canada. 5.25 miles installed without protection showed no trouble whatever. The remaining 23.41 miles installed without protection had twelve cases of electrolysis partly caused by defective bonds.

Seven cases of trouble were caused by defective splices. Ten cases of trouble were caused by workmen digging for water and gas pipes. In one case a temporary installation only ten inches deep was allowed to remain until it was plowed out and caused considerable trouble.

Various forms of mechanical protection were used on 15.72 miles of cable in this group. In some cases the cable was wrapped with building paper and concrete or boards were laid over it. Four cases of trouble in which the sheath was corroded and full of holes for 30 to 50 feet occurred near stockyards and gas plants. Eight cases of trouble were caused by work-

men of water and gas companies who dug through all protection.

Chemical Action and Lightning Also Damage Cable

Data were collected on 16.34 miles of cable in service for a period of five years. The sizes installed were 25 to 300 pairs. On 3.04 miles installed without protection, no cases of trouble had occurred. On 11.30 miles installed without protection several cases of trouble were caused by workmen. One case was due to electrolysis and three cases were due to chemical action where drainage from drug store, ice plant and blacksmith shop emptied near the cable. Two cases occurred near filled-in earth. Several cases of trouble were due to lightning.

Two miles of cable installed with tar paper and board protection had three hundred feet badly corroded near cinders and had three cases of trouble near barns and manure piles. There was also some trouble from workmen digging for water and gas connections.

Decay of Board Protection Starts Corrosion

Data on cable in service six years covered 5.67 miles. 3.17 miles installed without protection showed no trouble. 2.5 miles covered with cypress boards developed two cases of trouble probably from chemical action caused by decay of the wood strips.

Data on 31.47 miles of cable in service for seven years were collected from twelve states. 3.69 miles installed without protection had no trouble. 25.54 miles installed without protection was disturbed very little by workmen. Two cases of trouble occurred where a bridge washed out. Several cases of trouble were caused by chemical action near stables, toilets, lead mines and in cinders. No trouble was reported on 2.34 miles using some form of protection, tar paper, oak boards, creosoted boards or concrete.

Results were reported on 8.98 miles of cable in service for a period of eight years. 4.98 miles installed without protection was very little disturbed by workmen. Several cases of lightning trouble occurred. There were a few cases of chemical corrosion near stables and toilets and two or three cases of electrolysis. A few slight cases supposed to be from chemical action occurred in four miles of cable laid in sand and covered with cypress boards.

Workmen Dig Through Concrete Protection

Information from eight states covering 29.43 miles of cable installed ten to twelve years showed for the greater part of the cable very little trouble from workmen. Several recent cases of trouble were attributed to chemical action from stable refuse, cinders, packing house sewage and alkali conditions.

On three miles where tar paper and concrete protection was used considerable trouble was experienced from workmen digging through the cable protection and the cable. One case was thought to be electrolysis. Two cases near ash piles were thought to be chemical action. In one case water collected in the pipe up the pole and then froze crushing the cable.

The oldest cable reported had been in service for a period of 17 or 18 years. The total length was 3.5 miles. There were very few cases of trouble due to workmen digging into the cable.

Only Two Companies Dissatisfied

In the entire survey only two companies were dissatisfied with their experience. One company had a short length installed in a street where chuck holes were formed by traffic and disturbed by cable causing considerable work in locating and repairing the trouble. In the other case, one-half mile of cable with defective sheath was installed and much trouble was experienced in locating the trouble and making the needed repairs.

ONE MAN CABLE TEST

How One Man Can Identify Cable Pairs

A TELEPHONE ENGINEER subscriber asks that we publish an article illustrating the method which will enable one man to test and identify pairs in a cable, without the assistance of a helper. There may be several variations of the method, but the description in the following paragraphs and the accompanying illustrations show a method which has been found to be practicable.

The first test is to see that all pairs of the cable are clear; that is, are not crossed with other pairs or grounded on the sheath. The ordinary method of testing is to see that all pairs are clear at one end and at the other end to strip off a small length of insulation and tie the bare ends together into a bunch. The bunch of wires is then connected to the lead sheath. Pairs are taken from the bunch one by one and each conductor is tested either with a receiver and battery or with a buzzer to see that they are not crossed or grounded.

After the pairs are tested for crosses and grounds, the connections to the terminating cable at the central office are made at random without regard to numbers at distant end, thus completing the connection to the main distributing frame. After the connection to the frame is completed temporary ties are made from the red conductor of pair No. 1 to the white conductor of pair No. 2, from the red conductor of pair No. 2 to the white conductor of pair No. 3, etc. The test buzzer or a battery of a few volts is connected from the white conductor of pair No. 1 to the sheath. The tester now goes to the distant end of the cable to pick up the pairs.

At the distant end he connects one terminal of his telephone receiver to the cable sheath and tests the conductors until he locates the wire which has the battery or tone on it. This is obviously the white wire of pair No. 1. He then twists the ends of both conductors of pair No. 1 together and attaches a tag or passes the pair through a numbered hole in a strip of leather. The tone will now be found on the white conductor of pair No. 2 since that conductor is connected to the red conductor of pair No. 1 in the office. After pair No. 2 is identified and tagged the ends of pair No. 1 are separated and the white conductor is connected to the red conductor of pair No. 2. The tester will now find the tone on the white conductor of pair No. 3. This process is carried on until all pairs are identified and tagged.

If only a small number of pairs are to be picked out of a larger cable as at a branch splice, time will be saved by placing tone on all of the pairs that are to be picked up so that they may be separated from the rest of the cable before the individual pairs are identified. These pairs can then be identified and tagged as described above. Details of the testing methods are shown in the illustrations.

—Staff Contribution.

Bureau to Transmit Standard Radio Wave Signals

As a result of preliminary tests, the decision has been reached at the Bureau of Standards to transmit at certain intervals standard radio wave signals for calibration purposes. These signals may be used by laboratories to calibrate measuring instruments and by those who have receiving sets to know where the set must be tuned to receive certain wave lengths. The first transmission was arranged for March 6, and will include wave lengths ranging from 550 to 1,500 meters. Transmission of other wave lengths will be announced later. Anyone interested can secure full information by writing the Bureau of Standards.

How Rates Are Made Today

A Discussion of the Present Method of Determining Telephone Charges—Problems that Come with Monopoly—The Necessity of Giving Relief in Time

By C. A. Wright and D. B. Judd

Public utility commissions have generally based rates and amounts of securities and dividends authorized on "fair valuations." Ordinarily these fair valuations are estimated costs of reproduction, less depreciation, under normal conditions, checked and possibly in some cases modified by original costs and the amounts of outstanding securities issued against the property.

An equitable rate has been considered to be one which will enable the telephone company to pay all expenses of operation and a return on the invested capital which will attract a sufficient supply of new capital to extend and develop the telephone service to the extent demanded by the public.

Effects of Monopoly

The tendency in the last few years has been to eliminate duplication of telephone equipment in the telephone operating areas by granting the telephone companies monopolies in their communities. National and state laws preventing the purchase of one competing company by another have been repealed in many cases, and many consolidations of competing telephone companies have been effected.

There has always been a tendency in smaller communities on the part of dissatisfied telephone subscribers to organize new and competing telephone companies. Such companies have frequently been unsuccessful financially and the operation of competing companies has always been harmful to the telephone service. The organization of such companies is now generally prevented by public utility laws which require that a "certificate of convenience and necessity" be granted a new telephone company by the public utility commission before the newly organized telephone company is allowed to operate.

When more than one telephone company operates in any community the resulting duplication of equipment increases the cost of the service, and the value of the service to the subscribers is greatly decreased because of the decrease in the number of subscribers to which any one subscriber has access. For these reasons monopoly is an advantage in the production of telephone service, but under the existing conditions the elimination of duplication of telephone plant and service, has been accompanied by the elimination of competition, and the result of this elimination has been a tendency of the telephone companies to cease trying to provide the best service as economically as possible.

Lack of Incentive

This general policy of rate making does not then give an incentive to the telephone companies to initiate more efficient methods of giving service. If their cost of production is decreased there is a tendency for rates to be decreased, and the result is that efficient management has been penalized. If through inefficient management the cost of telephone service is high, the "cost plus" system of rate determination provides the additional revenue necessary, and encourages the management in its inefficiency.

Public utility commissions are generally authorized to set service standards and enforce them, but because of the great amount of expense involved in evaluations and similar work which they must do, there is little opportunity to set and enforce such standards. There is little incentive for the efficient management to provide the best service, when it gets no credit for it, and when the inefficient management provides poor service more conveniently and with less cost.

The existing system of rate determination in this manner rewards careless and inefficient management by guaranteeing a fixed return on the investment regardless of whether the telephone service is good or poor, and it discourages good management, because it prohibits a return greater than this fixed return, if the service is good.

As each valuation and rate study are made separately, it is an occasion for bargaining and scheming on the part of both the telephone company and the city council, or other representatives of the public to persuade the public utility commission to take action of advantage to one or the other.

Cost of Valuations

One public utility commission has in some cases allocated the total expense of producing the service to business, residence and various other classes of service, apportioning the cost in accordance with the use made of the service. The apportionment of rates for various classes of telephone service is generally determined by other factors than cost; for example, habit or custom, value to the subscriber, and the necessity for controlling the development of certain classes of service.

It has been suggested that an allocation of expense in accordance with cost would give results differing greatly from the allocation determined by the above factors, but the cost studies of the commission have indicated that this is not the case. It has also been urged that it is difficult and over-expensive or even impossible to correctly allocate the expense. The commission's cost studies indicate that it is not impossible to do this, and further experience will show whether or not the benefits gained from such a cost study justify its expense.

Even if no attempt is made to allocate the expense of operation, and the rates are based upon the total cost of producing the service, the expense and inconvenience of this method of determining rates is great. The entire time of many regulating commissions is given up to making valuations and determining rates, based upon the cost of plant and of operation, leaving little time for setting and enforcing standards of service.

If, as has happened during the past few years, the commissions grant many rate increases, the suspicion of the telephone using public that the commissions are prejudiced in favor of the utilities is aroused, and some of their effectiveness is lost.

Elements of Injustice

The existing system of rate determination is frequently unjust to telephone companies or subscribers. As suggested above, it may penalize economical management and good service, and it may encourage uneconomical management and poor service.

The large and powerful telephone company has an advantage over the its cause with the public utility comsmall telephone company in pleading missions because of its more able and more numerous personnel, because of its more extensive sources of information and because of its greater influence. Of course such an advantage works an injustice to the smaller telephone company.

Telephone companies are not protected from all risks now, even though the return on their investment is limited by public utility commission regulation. In times of rapidly advancing prices public utilities are frequently in financial distress, and occasionally some of them would be glad to discontinue their business.

In some such cases they have been compelled by public utility commissions to continue to furnish service at a loss. It has been suggested by public utility economists that this condition might warrant the appropriation by the state in years which are "fat" ones for the utilities of part of their income, and financial relief by the state in "lean" years.

Prompt recognition by the commissions of the condition of the utilities and relief by the granting of increased rates would probably be a more satisfactory and practicable means of eliminating such injustice, even though it would require a considerable amount of courage on the part of the public utility commissions to face the popular disapproval.

A source of occasional injustice to public utilities is the regulation of rates and assessment of taxes by independent state commissions which frequently act independently of each other and of other state and federal government agencies which perform similar functions. Many other possible conditions of injustice might be suggested.

Fairness of "Cost Plus" System

The justice of fixing as fair rates for telephone service those which will cover the average cost of service and allow a reasonable return on the average investment of a large number of telephone companies of the same size and same general character can be well defended.

Under a condition of unregulated competition, the rates of telephone companies would be sufficient to cover the cost of producing the service, and provide a return on the investment which would consist of interest equivalent to the return on money invested with the greatest possible safety plus a profit which would vary with the risk of the investment.

If the risk were eliminated investors would be willing to invest in the telephone companies, if the rates covered only the cost of service and interest which the safest possible investment would yield. The granting of monopolies to the telephone companies in their communities removes much of the speculative risk from the investment. Probably the greatest risk to the success of any such enterprise is that of competition.

If the management is efficient, the risks of obsolescence, and fire, wind, flood and other casualties may be provided for, so that a return on the investment which equals interest plus a very small speculative profit, will be sufficient to attract new capital to the telephone companies. Under such a condition the "cost plus" system of rate determination would be a just one for fixing average rates for a number of telephone companies of the same size and same general character.

The risk of competition has been in large part removed from the telephone business by the various states in order that they may more effectively provide telephone service. The people of these states rather than the telephone companies or telephone subscribers are entitled to the amount equivalent to the resulting decrease in the telephone rates.

Actually, the telephone subscriber gets this saving in the form of decreased rates which partly compensate for the over burdensome taxes which are assessed by the various states upon the telephone companies and in turn passed along by the telephone companies to the telephone subscribers in the form of increased rates.

This gain in economy because of monopoly and the amount of taxation are probably of the same order of magnitude, so that the total effect of these conditions is that the telephone subscribers pay for the monopoly advantages granted by the states with part or all of the taxes assessed upon the telephone companies by the states. The telephone subscriber pays a rate which may equal that he would pay under a competitive system in which the telephone companies are not taxed.

Because of the great social benefit to the state which results from the development in small communities of telephone service, these taxes might well be used to subsidize the telephone companies in the smaller communities where it is particularly difficult to obtain rates sufficient to pay for the telephone service needed, because the people have not been educated to a realization of the great economic advantage of the telephone, and because the cost per station of construction of a small telephone system is great on account of the great distances.

In such communities the need for telephones is greatest and a valuable social service is performed when a telephone system is installed. In such cases it is sometimes necessary and desirable that aid be extended in the development of the telephone service and it would probably be satisfactory to aid the telephone company by state subsidy than by financial help from the telephone companies of the larger towns and cities.

The provision of such aid, however, is not associated with the plan for rate determination proposed to any greater extent than with the methods at present followed. It would thus seem that the present "cost plus" system of rate determination were fair for the average company. The average quality of service of a group of telephone companies may be considered to be of acceptable grade, and it may probably be assumed that the average efficiency of management is good. When we consider the individual company, however, modifications in rate must be made to take account of unusual conditions.

Indefiniteness of Present System

An advantage which may be advanced by some in favor of the present method of determining telephone rates is that it is exact and definite. If this were so it would be a strong argument in its favor, but it is not so. Frequently records are not available from which to determine the original costs, and in determining the cost of reproduction it is necessary to guess at many costs.

The element of "going value" is one which affords much opportunity for differences of opinion, and there may sometimes be difficulty in deciding what portion of a telephone plant is used and useful in giving telephone service. Many other possible sources of error may be suggested.

Arguing in favor of basing telephone rates upon service rendered rather than upon the cost of giving the service, one public utility commission has made the following statement:

"In the entire scheme of rate making the valuation of the property is only an aid, an approximation. No matter how expensive or how cheap the property of a utility may be, the public is only interested in service, and for that service it should pay a fair price; but it is absurd to contend that the enormous sum of money in-

vested in antiquated equipment, furnishing inadequate service by ancient methods discarded in the intelligent progress of the art, entitle a company to higher rates, than better service furnished for less money invested in more cheap, simple and up-to-date equipment.

"The factor of management has more to do with earnings than all the hypothetical reproduction and conjectural depreciation compiled by all the engineers and commissions that have considered them. The public cannot be expected to pay rates on unnecessary property, extravagant construction, improvident investment, or excessive facilities not yet demanded."

In regard to the "reproduction less depreciation" theory of determining rates urged by the telephone company in question, the commission stated:

"This method of determining value usually included percentages for engineering service never rendered, hypothetical efficiency of unknown labor, conjectural depreciation, opinions as to the condition of the property, the supposed action of the elements, and of course its correctness depends upon whether superintendence was wise or foolish, the investment improvident or frugal.

"It depends upon probability rather than reality; it is based on such half truths that it bears only remote resemblance to fact, and rises at best to the plane of a dignified guess."

While many public utility commissions and telephone men may not entirely agree with this statement, it is a strong indication of the indefiniteness and inexactness of this method of determining rates.

Allocation to Communities

If only one class of telephone service were furnished by a telephone company, each subscriber would pay an equal share of the operating revenue of the company, but telephone companies generally have to supply direct or party line business and residence service at flat rates, or in some cases at measured service rates, rural or farm line service, post-payment or prepayment pay station service, and private branch exchange service.

Extension sets and extension bells must be provided where required and provision must be made for "switching" lines of co-operative or farmers' mutual companies which own and maintain their own lines.

Two-number and particular-person toll or long distance service must be offered which requires the adoption of an initial period and rate, and a rate for conversations which extend beyond the initial period. Special rates must be given at night to induce the public to use long distance lines during hours of "light load." Report charges must be made to prevent unfair use of telephone service by means of a prearranged code of reports.

It is apparent that the determination of such a rate for each of the above classes of service, that no injustice will be done any of the subscribers, and that the total operating revenue will be sufficient for the continued operation of the telephone company is not an easy problem.

Each business or industry should be self-supporting. A test of its value to its community is the willingness of consumers to pay enough for the commodity to support the industry.

A telephone company should, according to this point of view, be self-supporting. This has not always been the base. There are cases where the telephone systems have been supported in part by systems elsewhere, so that competition might be destroyed by providing service at low rates or so that telephone service might be developed in small communities which have not realized the value of the service.

Rural service was developed under unfavorable conditions. Most companies found it hard to induce farmers to buy telephone service and as they were anxious to develop this service they made rates which were very low. In many cases service of this kind is not nearly self-sustaining and is being paid for largely by the city subscribers. It has been assumed in this plan for rate determination that the telephone service in each community should be self-sustaining.

It might appear at first sight that each class of telephone service should be self-supporting, but this is not always the case. In the long run each class of service should support itself.

If a class of subscribers will not pay rates sufficient to cover the cost of the service provided, another class of service should be developed for them which will be self-supporting. However, it is frequently necessary to give a class of service temporarily at such a rate that it is not self-supporting in order that it may be developed to the point where it will pay for itself.

In any attempt to apply this principle it must be remembered that it is practically impossible to justly allocate certain elements of cost to the various classes of service, and that the development of some classes of service, as residence, increase the value of other classes of service, as business, so that the cost of such development should be distributed in proportion to the increased value, in so far as it is possible to determine it, over the various classes of service benefitted.

In most cases it is of course impossible to determine except approximately, this increased value. This plan for rate determination is not in any way dependent upon the possibility of so allocating local telephone rates.

The cost of toll or long distance service is generally affected by the distance over which the connection is established, the length of time the equipment is in use during the call and the operating cost of establishing the connection. Sometimes the length of the connection or the route affects the operating cost, as when the services of a "through" operator are required, or when supervision by two operators instead of one is necessary.

There has been much discussion as to whether toll rates should cover the entire cost of toll calls from subscriber to subscriber, or only from toll switchboard to toll switchboard. If, as has been done by at least one public utility commission, the subscriber to subscriber cost is assumed, it will be found that in many cases toll service is not self-sustaining.

If toll service is partly supported by exchange rates higher than necessary to cover the cost of exchange service, the development of exchange service may be retarded, or if toll rates are too high, toll development may be retarded. An extreme case of injustice is that of communities in which free toll service to other communities is provided. The local exchange rates are higher for all subscribers in order that a few subscribers may have the benefit of such free toll service.

Too low toll rates might be justified in some cases, however, because toll service is an asset which increases the value of the telephone service to all exchange subscribers.

There have been many cases where public utility commissions, acting for the public welfare, have ordered telephone companies owning and operating toll lines to permit other companies to route calls over these toll lines. In such cases, in justice to the companies owning the toll lines, they have prescribed rental rates which would more than make this service self-sustaining.

If toll service is not self-sustaining, some communities by paying more than the cost of the toll service they use, might indirectly partly support the local service in other communities where the rates for toll service do not support it. It is assumed in this plan

for rate determination that the rates for local and toll service should be mutually independent.

It may seem that in addition to cost, the rate for each class of local and toll telephone service is affected by habit and custom, value of the service to the subscriber, competition and unfair influence, the necessity for developing various classes of service and for preventing waste and unfair use of service, and the necessity for making the method of charging simple and easily understandable to the average subscriber.

It may seem that the cost of each class of service is relatively unimportant, but this is not so. Each class of service should ultimately be self-supporting. If it does not promise to be so, it should be replaced by some other class of service which will ultimately support itself.

Requirements of New System

The method of determining telephone rates by providing that they shall be high enough for each telephone company to cover the cost of giving the service and provide sufficient return on the investment to attract new capital has been adopted by law in many states. It is the plan which is now in operation. If any other plan is to be adopted, it would have to be shown that it promises to be more logical and fair and definitely better than the plan followed at present.

Any new system of rate determination or any modification of the present system should tend to correct the apparent faults in the present system which have been suggested. It should accomplish the following results.

1—It should offer an incentive to telephone companies to provide the best possible telephone service and to provide it as economically as possible.

2—It should make less burdensome and expensive the work of the public utility commissions and the telephone companies.

3—It should not increase the number of conditions which work injustice to the telephone companies or telephone subscribers.

4—It should not involve any more guesswork than the present system of rate determination.

Telephone Warnings Outspeed Tornado; Lives Saved

Abilene, Tex.—When a tornado was seen swooping down through a strip of territory near Dudly, Tex., recently, G. W. Williams, telephone operator, telephoned hurried warnings to subscribers in the path of the storm to seek safety. As a result it is believed a number of lives were saved, as the populace fled to cyclone cellars.

D. W. Gretorex, Minnesota Association Worker, Is Dead

Blue Earth, Minn.—D. W. Gretorex, vice president and general manager of the Blue Earth Valley Telephone Co., died here recently. Mr. Gretorex was one of the best known telephone men in the state and had long been identified actively with association work. At his death he was the second vice president and a director of the Minnesota Telephone association. The association, through Jay Greaves, D. M. Neill and H. F. Lueders, members of the resolutions committee, sent the family here a resolution of sympathy.

Corrington Succeeds Codington at Auburn, Neb.

Auburn, Neb.—L. M. Corrington has succeeded George Codington as manager of the Auburn branch of the Lincoln Telephone & Telegraph Co. Mr. Codington organized the Auburn Telephone Co. about 20 years ago and afterward sold it to the Lincoln company. The new manager has been with the company eleven years.

R. E. Driver, Auditor, Is Transferred to New York

New York, N. Y.—R. E. Driver, division auditor of receipts of the Chesapeake & Potomac Telephone Co., of West Virginia, has been transferred to the staff of C. A. Hess, comptroller of the American Telephone & Telegraph Co., at New York. W. H. Brandt, of Washington, succeeds Mr. Driver.

W. L. Burbridge Resigns; Lucas Is Successor

Lacon, Ill.—W. L. Burbridge, manager of the Citizens' Telephone Co. for several years, has resigned to devote his time to private interests. E. Lucas, of Peoria, has succeeded him.

Lima, O.—N. L. Michael has been elected to the board of the Lima Telephone & Telegraph Co. He succeeds John B. Kerr, deceased.

Powell, Tex.—J. B. Germany has sold the Powell telephone exchange to H. W. Weir, of Mount Pleasant.

A Job Awaits "Grad." in Bombay, India

Wanted—Present address of party who advertised over signature of "Grad." in our issue of October last. The Eastern Electric & Trading Co. of Bombay, India, wants to know if "Grad." will come there to work and if so, on what terms. Advise promptly: TELEPHONE ENGINEER, 28 E. Jackson Blvd., Chicago.

New York Telephone Convention at Rochester, April 18-20

The annual convention of the Up-State Telephone Association of New York will be held at Powers Hotel, Rochester, New York, on Wednesday, Thursday and Friday, April 18, 19 and 20, 1923. J. G. Ihmsen, vice-president and general manager, writes that the exhibits will be double the number shown at the last convention, and the attendance three times as great as at the first meeting. An operators' conference will be conducted the two last days of the convention.

Lead-Eating Rats Put Hundreds of 'Phones on Blink

Marion, Ind.—Several hundred telephones in Marion recently went wrong and subscribers were given a verbal jazz when they tried to get service. Ed Knipple, manager, reports that the cause of the trouble has been discovered. A lead-eating rat gnawed through a cable, imprints of its teeth being plainly visible when the trouble was located. Moisture got into the line through a hole an inch in diameter. The rat has not been found.

Safety Program Makes Big Cut in Lost Time Accidents

Richmond, Va.—Three years of accident prevention work has made a big cut in the number of loss of time accidents among the workmen of the Chesapeake & Potomac Telephone Co. Records show that in 1919 there were fifty-five accidents; in 1922, only two within the state of Virginia.

Commission Grants Permission for a Rate Increase

Harrisburg, Pa.—The public service commission, refusing an increase in rates that would amount to $163,000, has granted the Kittanning Telephone Co. permission to schedule an advance in rates which will net it $150,700 yearly. The company has about 5,000 subscribers and operates exchanges in Kittanning, Ford City, Leechburg, Rural Valley and Apollo.

People's Telephone Co. Buys Properties of "Home"

Morristown, Tenn.—The People's Telephone Co., of Knoxville, has purchased the lines and equipment of the Home Telephone Co., of Morristown. The latter company was owned locally. The People's company operates exchanges in Knoxville, Maryville, Jefferson City, Dandridge, Clinton and other eastern Tennessee towns.

Practical Plant Problems

Chapter XII—Interior Block Distribution Systems (Continued)

By Charles W. McKay, Associate Editor*

The subject of Block Distribution Systems, was discussed, in a preliminary manner, in the February installment. In the present installment we will consider the engineering problems involved.

At first thought, it may seem to the reader that the engineering problems, incidental to the preparation of plans and specifications for interior block distribution systems, may be negligible. Possibly this is true in the case of the smaller towns and cities. Be it remembered, however, that in cities such as Chicago, New York, Cincinnati and so forth, a relatively large area must be served from cables placed within city blocks. These cables may take the form of "interior block cables"; "house cables" or a combination of the two.

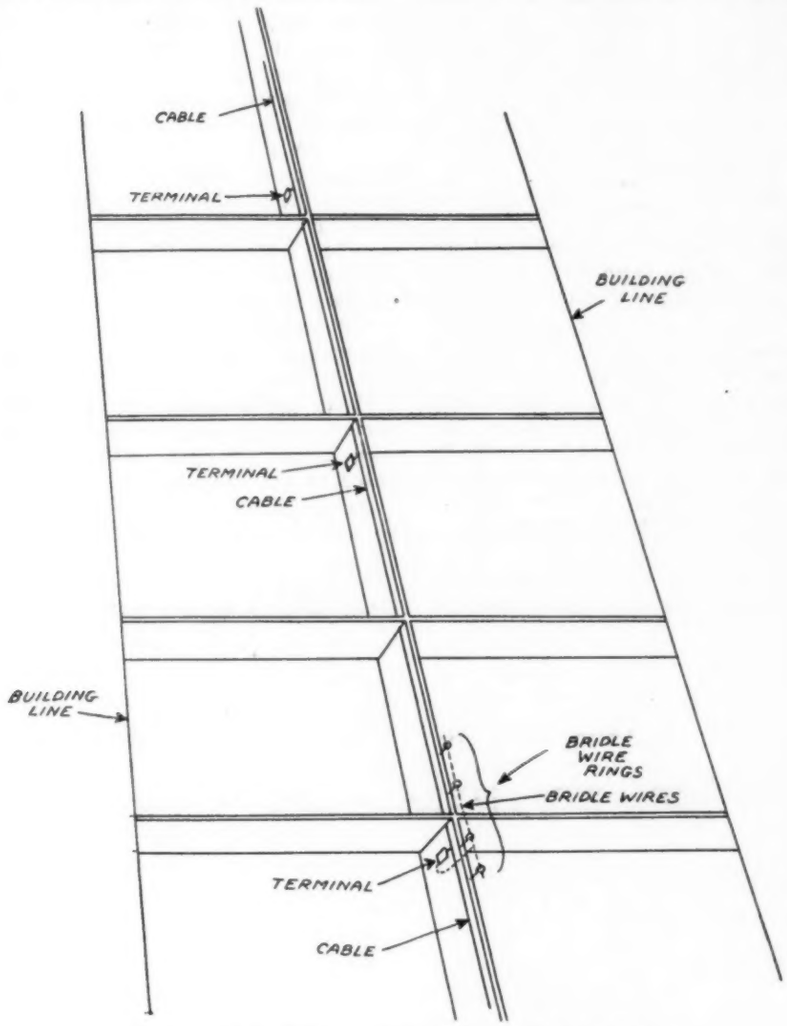


Fig. 25—Perspective View of Interior Block Distribution System

Block Cable Systems

Fig. 25, presents a perspective view of the interior of a city block, showing the location of the cable on the rear fences; the location of cable terminals; the location of the rings used for attaching the drop wires and so forth. In this connection, it is interesting to note that drop wires within city blocks are usually referred to as "bridle wires."

Reference is made to Fig. 25, at this juncture, merely for the purpose of directing the reader's attention to the correct relation between the various elements of an interior block distribution plant. In a subsequent portion of this article further reference will be made to the same figure—in connection with a more detailed discussion of the proper method of attaching block cables, block terminals and so forth.

In connection with the engineering work involved in the laying out of an interior block distribution system it is of course necessary to have a map (of the block in question), which presents a reasonably accurate notation of building lines, fence locations and so forth. Such a map is illustrated in Fig. 26.

The first step confronting an engineer—in making a survey for installing an interior block system—involves the transcription of the data resultant from the "house-count" study to the block map. In Fig. 26 it will be noted that small circular spaces are provided for each individual property. Within these circles may be noted the numbers of subscribers as found at the time of making the plan and the numbers of subscribers expected at the end of the five year analysis period.

After this data has been transcribed to the block map, the engineer should make a careful survey of the block, plotting the exact location of all proposed cable and also existing cables—if any. In the case illustrated in Fig. 26, it will be noted that an existing cable enters the block from the manhole at the corner of Avenue "C" and E. Third St. This cable extends approximately one-fifth of the way down the block and the proposed plans provide for the extension of the cable and also for the placing of a new cable from the manhole at the corner of Avenue D and E. Third St.

It will also be noted that existing cable is shown by a heavy, solid line

*Mr. McKay heads the organization of Charles W. McKay and Associates, Consulting Engineers, 646 No. Michigan Blvd., Chicago.

and proposed cable by a dotted solid line. The proposed subsidiary—from the manhole at the corner of E. Third Street and Avenue D., to the rear of the building at 21 Ave. D—is shown by a dotted and dashed line. Terminal locations are also designated, in this case, by the capital "T."

In connection with the subject of maps for use in plotting interior block cables, it may be said that such

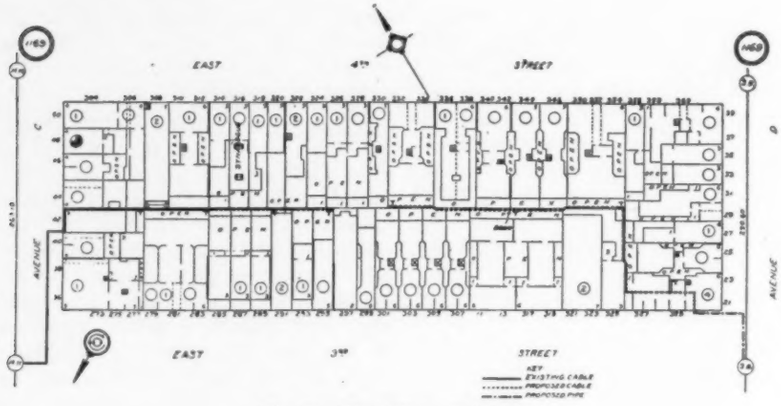


Fig. 26—Block Map; "A" Plan

maps may usually be obtained by making tracings from fire insurance atlases. From the tracing, as many blue prints as necessary may be made. In making the actual field survey, the engineer can designate cable and terminal locations by using a red pencil. After the plans have finally been worked out in detail, and approved, the cable and the terminal notations can be transcribed to the tracing (in ink) and as many work maps as desired can be made.

The topographical map (as illustrated in Fig. 26) showing the cable location, is usually known as the "A" print. Obviously, it would be out of the question to attempt to show sizes of cables and splicing details on the "A" prints. The "A" print is, therefore, usually accompanied by a "skeleton" cable lay-out—usually termed the "B" print, or the "B" plan. Such a plan is illustrated in Fig. 27. The distribution diagram presented in Fig. 27 is for the block illustrated in Fig. 26. The existing cable is shown with a full heavy line and proposed cable is designated by a dotted line. The short lines, at right angles to the distribution cables, designate terminals. It will be noted that the locations of the terminals as given in the "B" plan, correspond with the locations (addresses) as shown in the "A" plan. It will also be noted that the sizes of terminals are specified and the cable pairs to be terminated in each terminal. To illustrate—at the upper right-hand corner of the figure, we find a terminal described as follows—"location 350 to 354 E. 4th Street, rear 325 E. Third Street." The size of the terminal is specified as 16 pair (the symbol "X" being used in lieu of the word pair) and pairs 6 to 21 inclusive are to be terminated in this terminal.

At this junction, it may be well to add a word as to the difficulties involved in securing rights of way for locating interior block cables and terminals. Many property owners object to the placing of telephone cables and wires on their premises and it is usually necessary to obtain definite permission before the construction work is started—or for that matter before the block cable plans have been completed in final form. Again, many property owners will give the necessary consent—with the proviso that the cables be placed in certain locations.

For the reasons above indicated it is often necessary to accompany the plans with a detailed specification—describing exactly how the cable is to be run; where the terminals are to be located and so forth. If such a specification is provided, it is well to include detailed data as to the splicing features of the problem.

One of the large telephone companies issues definite rules for the preparation of block cable plans. For illustrative purposes, it may not be amiss to repeat these rules so that the reader may gain an idea how interior block cable plans and specifications should be prepared.

The rules follow:

"The following relates entirely to blocks in which the cable is run on fences or walls of buildings.

"Plans covering interior block distribution consist of specifications, permits covering all properties on which cable is to be placed, and two blue prints which are known as 'A' and 'B' prints.

"The specifications describe, in detail, the route which the cable will take and the various other details concerning the work.

"Wherever cable is to be placed on private property, a permit from the occupant, the owner or his representative, is secured and this permit shall be in the placing foreman's possession while the work is in progress.

"The 'A' print is a plan of the block showing all buildings, their heights in stories, the number of telephones in each, the open spaces and so forth, together with the address at which each terminal is located and the general lay of the cable.

"'B' prints show the theoretical pair distribution and the sizes of cables and terminals.

"With the exception of cross-connection boxes, iron boxes shall be used for all terminals which are exposed to the weather.

"In buildings where there will be no danger of low insulation (due to the use of silk and cotton-covered switchboard wire in terminating a block cable), a wooden terminal shall

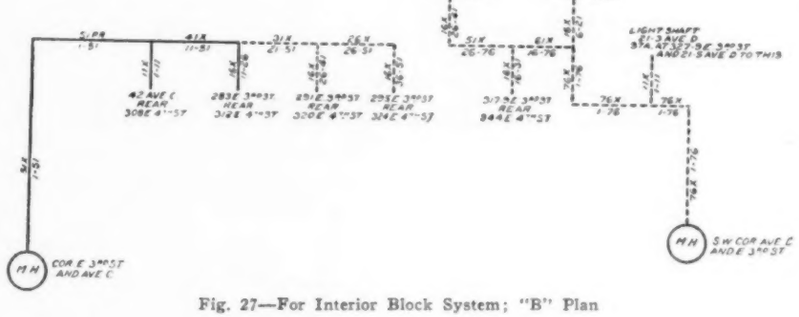

336 E 4TH ST. REAR 305 E 3RD ST
350-4 E 4TH ST REAR 325 E 3RD ST
LIGHT SHAFT E. 3 AVE. D
AND 21 SAVE D TO THIS
42 AVE C REAR 308 E 4TH ST
283 E 3RD ST. REAR 312 E 4TH ST
291 E 3RD ST REAR 320 E 4TH ST
299 E 3RD ST REAR 324 E 4TH ST
317 TO 321 E 3RD ST REAR 344 E 4TH ST
M H COR E 3RD ST AND AVE C
M H S W COR AVE C AND E 3RD ST

Fig. 27—For Interior Block System; "B" Plan

be used. In cases where a wooden terminal cannot be used (for the reasons above suggested) an iron terminal shall be installed.

"In determining the exact location of cables on fences or walls, the foreman shall be guided by the conditions in the block, and shall take into consideration—rear and side fences, taps

to buildings and windows (whether in the basement or first story) fire escapes, stairs, doors and so forth.

"Cables shall be run in a horizontal or vertical direction.

"When block cable is to be used on a wooden fence, it shall be placed on top of the fence unless conditions prevent.

"If cable cannot be placed on top of fence, it shall be placed on the side of the fence, directly under the capping.

"Cable should not be placed over boilers or near fire boxes, steam pipes or in any other extremely hot places.

"Cable should not be placed near the exhaust from steam, gas, or gasoline engines.

"Cable should be placed so as to be accessible at all points.

"Terminals should be so placed as to be within reach and accessible without annoyance to property owners.

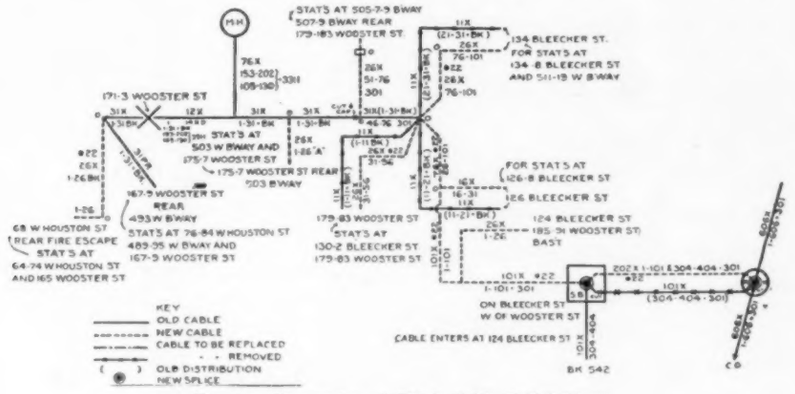


Fig. 28—Illustration of Block Cable Relief Plans

"When the cable is to be run on a brick building with a stone foundation, it shall preferably be placed on the brick wall of the building rather than on the rough stone wall of the foundation.

"Where cable is to be placed on a blank wall, on which there are no obstructions (such as windows, doors, and so forth), it shall be placed approximately 10 ft. above the ground. Where branches from the main cable are to be run into the buildings, the main cable shall be run directly over basement windows and the branches led in at the top of the window frames.

"Wherever possible, in making vertical runs, they should be made in the angle formed by intersecting building walls. If it is necessary to run a cable up the face of a wall, it should preferably be run close to the casements of the windows but shall not be placed near enough to loosen the bricks or so placed that the window shutters will not strike it. In no case shall vertical runs be made close to the corner of a brick building.

"Where cable is to be run in basement of a building (unless it will materially increase the length of cable to be used), it shall be placed on the walls near the ceiling.

"Cable should not be placed in contact with iron frame work of buildings, gas or water pipes or other grounded objects.

"Unless specified, no terminal should be placed so that access to it can only be obtained by roofs, sheds or skylights.

"In no case should terminals, other than cross connection boxes, be placed less than 5 ft. above ground—except where the height of the fence or right of way conditions makes it impracticable to place the terminal at the afore-specified height."

The foregoing instructions will give an idea of the detail to which some companies go in preparing plans and specifications for interior block distribution systems.

The distribution plan illustrated in Fig. 27, covers a comparatively simple case. A more complicated problem is illustrated in Fig. 28. It is thought that a detailed discussion of Fig. 28 will be unnecessary—but it is suggested that the reader review the illustration carefully—as it presents a rather interesting problem in block cable relief.

In Fig. 25, the relative locations of cables, terminals, rings and wires are indicated. Fig. 29 illustrates detailed methods of placing cables—on the top of rear yard fences; on the side of the capping or under the capping. The method of attachment by means of clamps is also illustrated.

The type of iron terminal used in connection with interior block cables is essentially the same as the type of terminal used for aerial cable distribution work. Such a terminal is illustrated in Fig. 30. Fig. 30 also shows an approved method of leading the bridle wires into the terminal.

House Cables

Plans covering house cable work consist of specifications; building maps or plans and cable layouts—similar to the "B" plans discussed under the caption "Block Cables."

The specifications should describe, in detail, the run of the cable through the building, the risers, the points at which terminals are to be located and the size and kind of cables to be used.

One set of blueprints should be provided, giving the floor plans of the building under consideration. The engineer, making the survey, can denote the exact location of all cables,

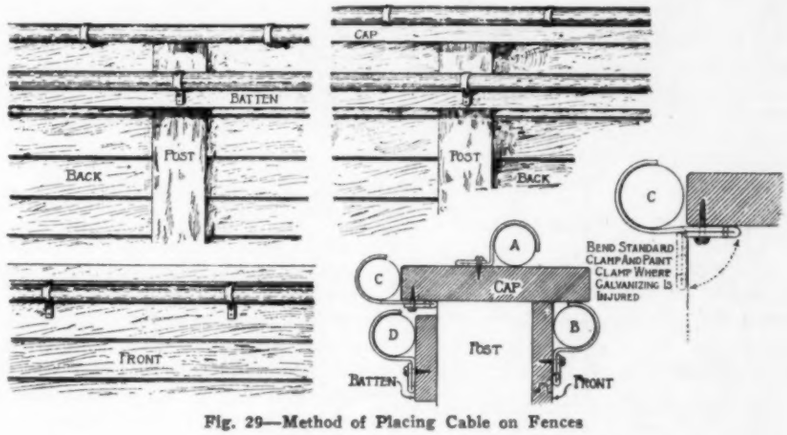


Fig. 29—Method of Placing Cable on Fences

terminals and so forth on these blueprints. Subsequently, the data may be transferred to the tracing and new prints made which will be available for the working forces.

House cable specifications should be prepared from the architect's plans before the construction is completed. Immediately prior to the placing of the cable a check of the proposed cable routes and of the proposed ter-

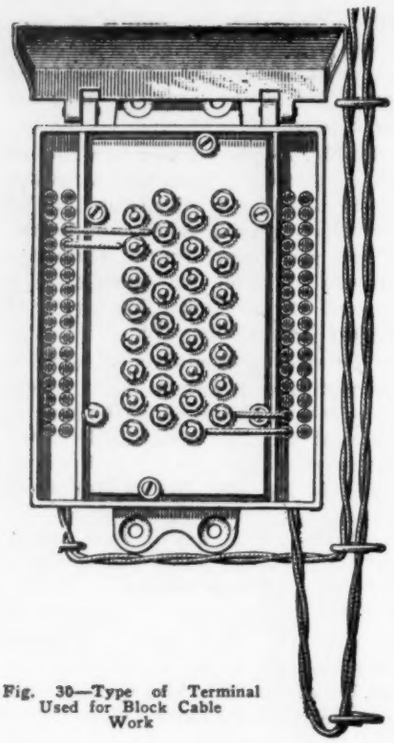


Fig. 30—Type of Terminal Used for Block Cable Work

minal locations should be made, in order to see that the plans—as laid out from the architect's drawings—are feasible from a practical standpoint. In other words, the terminals must be located in accessible places and cables must be so placed as to minimize installation costs and insure their protection from mechanical injury.

At the time of making this check, the engineer should be sure that all terminals are so located as to insure an economical distribution of the interior wiring.

In laying out a house cable distribution system, a splicing plan or diagram (similar to the "B" plan discussed under the caption "Block Cable") is necessary. Such a plan is illustrated in Fig.'s 31 and 32. The sizes of all riser and branch cables are specified and also the sizes of terminals. In this connection it may be said that it is customary to make a splice at every third floor. Referring to Fig. 32, it will be noted that

Fig. 31—House Cable Plan

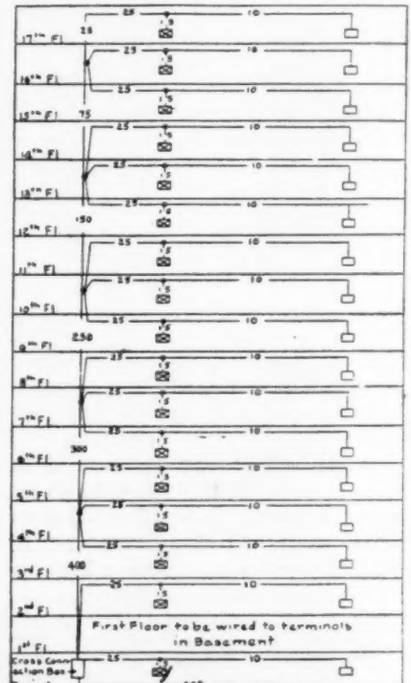


Fig. 32—Another Form of House Cable Plan

a splice is made at the fifth floor. From this splice a 25 pair cable is extended directly to the first terminal on the fifth floor; another 25 pair cable is extended vertically down the riser shaft to the fourth and thence horizontally to the first terminal on that floor. A third 25 pair cable is extended vertically up the shaft to the sixth floor, thence horizontally to the first terminal on the sixth floor.

In the case illustrated in Fig. 32, it has been assumed that two terminals will be required on each floor. In such a case paper insulated cables will be used to the first terminals and from this part to the second terminals silk and cotton insulated cable may be used. The reason for the latter stipulation will be obvious. The silk and

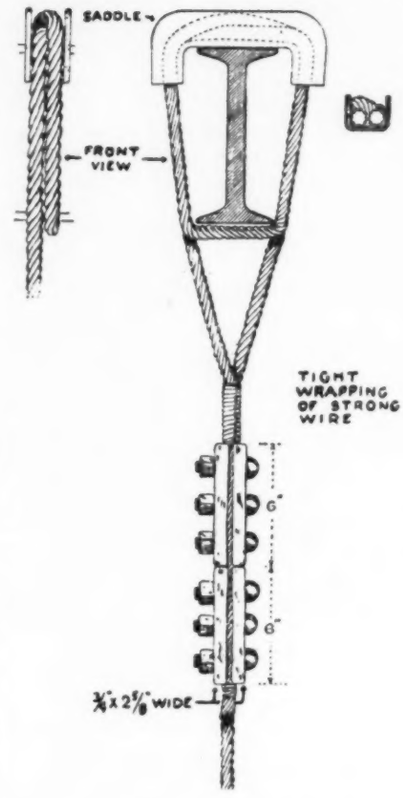


Fig. 33—Method of Attaching House Cable Strand

cotton insulated cable may be terminated directly in the terminal boxes at very small cost. Where cable lengths are short, the cost of silk and cotton insulated cable (terminated directly in the box), is less than the

Fig. 34—Method of Attaching House Cable to Strands

cost of paper insulated cable which has to be provided with especial terminating facilities.

It is thought that the foregoing will give the reader a general idea of the engineering problems involved in the planning of house cable systems. The construction features will be discussed more in detail in a subsequent installment of this series. For the present, suffice it to say that the riser cables are usually attached to a messenger strand. This strand must be securely attached at the top of the riser shaft. The method of attachment is indicated in Fig. 33 and the method of attaching the cable to the strand is illustrated in Fig. 34.

OHIO CONVENTION

Old Guard Retires After Many Years of Service—New Officers and Directors Elected

Declining re-election, after many years of service, the old guard of the Ohio Independent Telephone Ass'n retired at the Columbus convention, February 20-22, and Frank A. Knapp of Bellevue was chosen president to succeed Frank L. Beam. The other officers elected are: Conrad Kipp, Greenville, vice-president, and Frank L. McKinney, Columbus, secretary-treasurer. The executive committee consists of the three officers named, with G. P. Thorpe, Wilmington, and C. L. Jones, Athens. The board of directors includes W. L. Gary, Newark; A. J. Curran, Elyria; Harry Graham, Cygnet; C. L. Jones, Athens; Conrad Kipp, Greenville; Frank A. Knapp, Bellevue; Earl Lutz, Circleville; Frank L. McKinney, Columbus; E. G. Miller, Warren; W. A. Norton, Kenton; George Quatman, Sidney; J. Warren Safford, Troy; Fred L. Sears, Cambridge; Harry Sotzen, Shelby; G. P. Thorpe, Wilmington. During the past year the Ohio association almost doubled its membership. Retiring President Beam reviewed the growth of the telephone business during his twenty years of leadership in that state. Pres. MacKinnon of the U. S. Independent Telephone Ass'n said that success in the telephone business is a matter more of management than money; that capital always will be available where good management exists.

Porterville, Cal.—The Pacific Telephone & Telegraph Co. has started improvements here which will total $25,000.

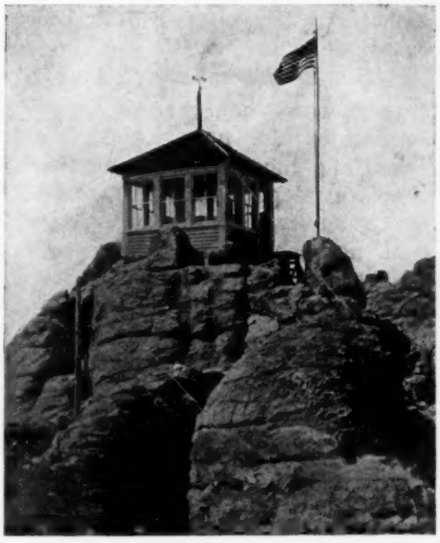
HELP FIRE FIGHTERS

Minnesota Telephone People of Much Value to the Forest Rangers

St. Paul, Minn.—Fire fighting work is of vast importance in the big woods country of Minnesota. In this battle the telephone wires play an important part. The town of Moose Lake, Minn., was destroyed by a forest fire in 1918 and ever since that time the people of the district have stood in fear of a repetition of the disaster.

Officials of the Northwestern Bell Telephone organization, in periods of danger, urge their employes, especially the operators, to be watchful and to give all the help they can to bring about 100 per cent service.

Last October a second conflagration threatened for a time and the girls at



—Photo Courtesy Northwestern Bell
A Government "Fire Lookout," on Harney Peak in the Black Hills. Note Telephone Connections Running Up to Small Building

the exchanges stayed on duty at that time as long as eighteen hours a day so that the rangers might keep in constant touch with the outside world. At that time practically every man available was on the "fire line."

The rangers, when it was over, did not forget the telephone operators. The Northwestern Bell printed recently the following letter received by Jack Kruger, manager for the Northwestern Bell company at Moose Lake:

"In making up a summary of the season's activities, we fully recognize the important part that good telephone service plays in the fire fighting game. The success of a fight on a fire line often depends upon the lines of communication. During the past season, we have had occasion to rely upon our telephone service with entire satisfaction. Our calls have gone through promptly, night or day. We wish therefore at this time to commend the personnel of the local telephone exchange for efficient service and courteous treatment at all times. With the compliments of the season, the State Forest Service."

The letter carried the signature of P. W. Swedberg, ranger, and O. S. Lind, patrolman.

Throughout the northern parts of the United States where forest fires are liable to occur, "firelookouts" are maintained by the government. There are many of these lookouts in the territory in whch the company operates. In each of these stations is a telephone, which is always at the service of the forest ranger.

The photograph of the "fire lookout" shown on this page was contributed some time ago by W. W. Friselle of the Chadron district office. It is known as the Harney Peak Ranger station, located in the Black Hills, and is the highest peak between the Rockies and the Himalayas.

Georgia Independent Telephone Association Organized at Atlanta

The Georgia Independent Telephone association, composed of 75 independent telephone companies in Georgia and designed to standardize the service of these companies throughout the state, was organized at Atlanta recently. Officers were chosen as follows: W. B. Bowen, Fitzgerald, president; W. R. Hunter, Quitman, first vice president; J. M. Dent, Douglas, second vice president; P. D. Fortune, Summerville, third vice president; J. L. Matthews, Statesboro, secretary-treasurer, and J. Prince Webster, general counsel.

Kansas City Telephone Headquarters Heated by Oil

On invitation of H. G. James, Mrs. C. Tobie, of Kansas City Telephone Co., made an interesting address recently before the Kansas City Oil Men's Club. In Kansas City the Telephone Company answers one million telephone calls a day; 97 per cent are answered in ten seconds, 98 per cent are established correctly. Kansas City completes a higher percent of her long distance calls than New York and does a bigger toll business than St. Louis and many other larger cities of the United States. The Kansas City Telephone Company uses from six to ten thousand gallons of oil per week to heat their building.

OPINIONS AND COMMENTS

PLANNING THE CONSTRUCTION PROGRAM

In the telephone business, the engineering viewpoint has been much more in evidence than in many other businesses and the ability of the business to weather storms in the financial world is partly due, we think, to the manner in which the business has been engineered. In spite of this, however, there are many ways in which the engineering of our plants might be improved.

The essence of engineering is planning in advance. We have all seen cases where telephone plants have been poorly planned and, as a result, corners on pole lines fail to stand up, switchboard equipment fails to meet traffic requirements and cables are too large in some sections and are filled to capacity in others. Many of these conditions should never have occurred and would not have occurred if proper foresight had been used.

With the spring coming and the reconstruction program again getting under way we are again facing the problem. Is our work going to be well planned to fit into a comprehensive scheme of development or are we going to patch on here and there in the same old hit or miss fashion that we have been doing for years? This is something work thinking about.

THE BELL REPORT

As usual, the Bell annual report is a document of absorbing interest to the telephone industry. It is the record of a year of achievement that eclipses all previous records. We have commented on the various factors that enter into the growth of the business, but this report sums up the results in a way that no brief comment can do.

No man who is interested in the future of the telephone business should fail to give the 1922 report a careful reading as in no other place can so comprehensive a survey of the business be obtained. It is of interest to all whether stockholders in the Bell system or not.

THE "HELD" ORDER

One of the common sources of dissatisfaction with telephone service is the order for installation or change of service which must be held for lack of facilities. This is especially true if the order is one for the moving of service from one address to another. The subscriber has had service and looks upon himself as a preferred customer who is entitled to service when he moves.

It is true that the giving of service in the new location is something more than the mounting of a telephone instrument on the premises, but the subscriber does not see the mass of detail that must be gone through to give him service. He has had service in the old place and does not understand why he does not get it, quick, in the new one. His water, electric and gas services are turned on; why not his telephone service?

During the period immediately following the war, there was an excuse for a large number of "held" orders, but this excuse can no longer be given. The telephone business is built on the proposition of furnishing service when it is needed, and America's telephone plants should now be able to furnish service without unreasonable delay.

Every plant should have adequate spare facilities by this time, or should have plans under way to provide them. There may be objections that some companies cannot finance extensions. Any company with reasonable rates can finance extensions at the present time and anyone that does not have adequate rates should take immediate steps to have them readjusted. Then it should show its good faith by making necessary extensions so that poor service because of slow installations can be eliminated.

MANAGERS WE'VE KNOWN

On an occasion when the subject of Accident Prevention was under discussion at a telephone meeting, one manager made the statement that there was no necessity of any work of that kind in his company, that all of the men were experienced men and that they had no accidents. In a measure, his statement was true as the company with which he was associated only employed a working force of some five or six men, and serious accidents had not occurred very frequently.

As a matter of fact, only about a certain number of lost time accidents occur per thousand workmen per year and with a force as small as six men it is probable that several years might elapse between serious accidents. This does not remove the responsibility of the management and this manager can not avoid the responsibility that will rest on him in case a serious accident does occur.

TELEPHONE ENGINEER

Vol. 27 March
No. 3 1923

Entered as second-class matter, June 6, 1922, at the post office at Chicago, Ill., under the act of March 3, 1879.

General Business and Editorial Offices, 28 E. Jackson Blvd., Chicago, U. S. A. Telephone: Harrison 4000.

W. H. Graffis.....Gen. Mgr.
R. V. Achatz.....Technical Editor
Chas. W. McKay.....Associate Editor
Herbert Graffis .....Bus. Mgr.
Jos. M. Graffis.....Advertising Mgr.
G. W. Sutton.....Eastern Mgr.
56 W. 45th Street, New York
Tel. Vanderbilt 3965

SUBSCRIPTIONS

The subscription price of TELEPHONE ENGINEER is $2 a year in the United States, Cuba and Mexico; in Canada it is $3; in all other countries $4. Single copies, U. S. A., 20 cents.

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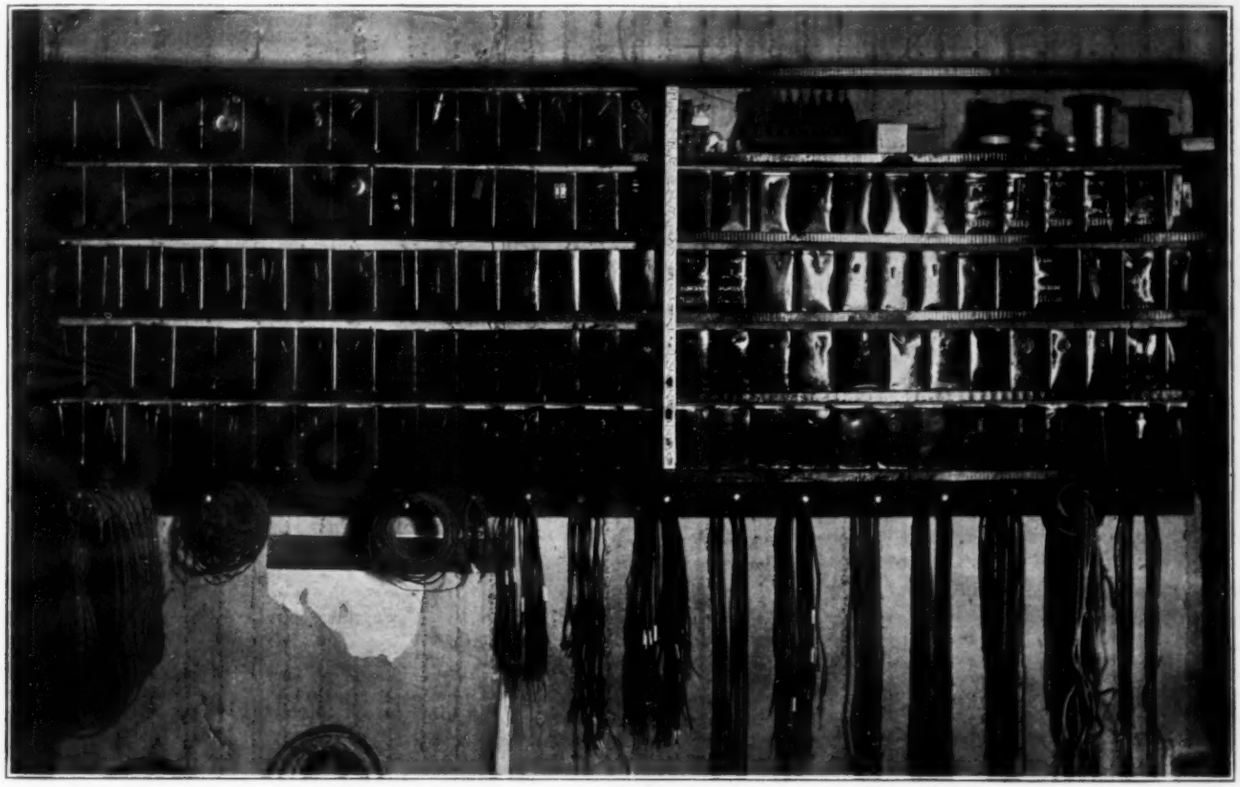
An incident that occurred in the plant of a neighboring company may be used to point the necessity of proper instruction of workmen along safety lines. Two men of a small gang came into contact with power wires and were rendered unconscious. One man in the gang had received instruction in first aid in another place and he promptly went to work on one of the men, applying the prone pressure method of resuscitation.

At the same time he directed the other men of the gang how to proceed with the second shock victim. In a short time both men were restored to consciousness and were little the worse for their narrow escape. Prompt action, plus a little knowledge, saved two lives.

The time has gone when any corporation, public utility or other, may evade its responsibility to its men and the time will soon be here when the manager or superintendent who does not provide safe working conditions for the men in the plant and does not see that they are instructed in safe working practices will no longer be tolerated. This will apply in small as well as large plants and managers of the type of our friend who does not need to do accident prevention work will have followed into deserved obscurity the type of manager whose policy in public relations was "The public be damned."



Put It Back Where You Got It

In an effort to contrive a convenient and an effective yet inexpensive arrangement for storing the numerous small parts essential to the operation of a telephone plant, the following plan was worked out:

A series of shelves, spaced a little farther apart than the height of an ordinary tin cigar can, were built. As many cans as needed were painted and a sample of what each contained was wired to the front of the can. Wood screws by sizes and type of head, nails, tacks, carbons, micas and small parts had their own cans. Various varieties of cords were hung on nails underneath the lower shelf.

On account of limited shelf room the lids of the cans were placed in three unused drawers in a desk, making additional space in which is kept machine screws and small switchboard parts.

The different sized small washers were taken care of by driving through a board about 8 x 12 inches long finish nails spaced about an inch apart. This board can be seen on the shelf next to the top.

Perseverance was needed in sorting materials, and everybody is constantly urged to follow the advice given on white strip running through the middle of the shelves—"Remember where you got it. Put it back."

(Contributed by O. C. Rynearson.)

OUR "LITERARY DIGEST"
Review of Recent Articles on Telephone and Allied Subjects.

"Wind Shielding Between Conductors of Telegraph and Telephone Lines," by P. J. Howe, Construction Engineer, Western Union Telegraph Company. Journal of American Institute of Electrical Engineers, Jan. 1923.

The author describes a series of experiments extending over several years which were designed to determine whether the commonly used formula for calculating wind pressures on cylindrical surfaces, $P = 0.0025\ V^2$, is correct when applied to design of aerial pole and wire lines and to find out if shielding exists between telephone and telegraph wires when they are carried on the same or different cross arms.

A special test structure was built and instruments provided for measuring wind pressure on a single wire and on ten wire cross arms and for measuring wind velocity. Curves are given in the paper showing the results of the tests under various conditions. The results indicate that the constant 0.0025 in the formula given above is correct within 8 percent for all values on the experimental curve. The formula, therefore, is suitable for use in calculating wind pressures on unshielded ice covered conductors.

A definite shielding effect was found to exist both between conductors on the same cross arm and between wire carried on different cross arms, two feet apart. The shielding on any given number of wires increases with the wind velocity and for a given wind velocity increases as the number of wires. On telephone and telegraph conductors coated with ice one-half inch in radial thickness at wind velocities corresponding to 8 pounds per square foot will run from a minimum of 39 percent to a maximum 51 percent on a fifty wire line.

Physical Interpretation of Complex Angles and Their Functions, by Aram Boyajian. Journal of American Institute of Electrical Engineers, Feb., 1923.

Mathematics is one of the most useful tools of the Engineer's equipment and he is continually endeavoring to perfect the connection between his mathematical symbols and the physical facts that they represent. Many who have studied the mathematical side of telephone transmission have found difficulty in attaching physical meaning to some of the complex mathematical expressions developed. To such will appeal the present article which attempts to give a physical interpretation to various types of angles. The fundamental idea of angle is associated with the idea of a percentage and a circular angle is explained as a percentage change in a line in a direction perpendicular to itself. A hyperbolic angle becomes a percentage change of a line parallel to itself and a complex angle is a combination of the circular and hyperbolic angles. The term "imaginary" thus becomes equivalent to a change in a quadrature direction. The author then proceeds to explain the trigonometric function in terms of the new conception of angles and gives examples to show the application of this new idea in physical problems.

Origin of Pupin Invention. Inventor tells steps in process of invention of inductance coil loading of telephone conductors. Sees end of loaded open wire lines and enormous development of cable.—By Michael Pupin. Reprinted from Das Fernkable, Charlottenburg, Germany.

The earliest ideas concerning wave-transmission occurred to me about fifty years ago when I assisted during the summer school vacation the village herdsman in his duty of watching the village-oxen during the grazing operations at night. The herdsmen of my native village had a system of signalling through the ground and on very dark nights they caught the sounds made by the grazing oxen by pressing their ear against a knife blade which was stuck into the ground. I learned from the herdsman of my native village in Idvor, Banat, that a solid and dry soil transmitted sound much better than air or freshly plowed-up soil.

In 1894 I was studying the historical Lagrangian problem of the free motion of discrete small masses attached to a weightless string, the motion being free from frictional resistances. I extended Lagrange's solution so as to make it general, including the weight of the string, frictional resistances and considered both free motion and that produced by an impressed harmonically varying force. This solution I obtained while passing my summer vacation at Wannsee, Switzerland. While making a foot tour through Switzerland during that summer it occurred to me that my general solution of the Lagrangian problem had a practical application in telephony.

I was quite familiar with the Hertzian experiments on electrical waves and I saw in these experiments the importance that wave length plays in electrical wave-transmission. Neither Vaschy nor Heaviside ever even mention the wave length in their theoretical discussions of telephonic transmission.

After finishing my mathematical work concerning electrical wave transmission over a telephone conductor with inductance coils placed at periodically recurring points and at distances prescribed by the wave length which is to be transmitted, it was necessary to devise an experimental method which would enable me to investigate the whole matter in my laboratory without going to the American Telephone and Telegraph Company and asking them to lend me their long distance overhead lines or cables. I succeeded finally in working out the theory of artificial lines and made several of them. This was a rather difficult and time consuming part of my work.

The study of inductance coils with iron cores was then taken up and in this I was much guided by the beautiful bridge method worked out by my friend, Professor Max Wien. Neither the mathematical nor the experimental part of this work was ever published by me, but both the American Telephone and Telegraph Company and Siemens and Halske of Berlin were informed by me of the results of this investigation and of the method which I employed in order to obtain these results. They both have employed this method since that time. I was never very enthusiastic about the employment of the Pupin-coils on overhead lines and always advocated their insertion in telephone and telegraph cables because I always believed that cables offer the best protection against lightning, storms and sleet. The latest principle in America and in Germany bears me out. The time is very rapidly approaching when telephonic transmission with Pupin coils will be over cables only and overhead wires will be reserved for multiplex telephonic transmission by modulated high frequency waves. This has been made possible by the employment of the three electrode vacuum tube for reception and transmission of high frequency electromotive forces.

Telephone engineers in the United States agree with me in the opinion that telephonic and telegraphic transmission over cables is entering a period of enormous development.

Valuation in Rate Making

Chapter XII—Unit Costs (Continued)

By Charles W. McKay, Associate Editor*

In the February installment, the problem of evolving unit costs for the underground cable plant, was discussed in some detail. The illustrations cited—in connection with splicing work—were based upon the assumption that one splice would be required for every section of cable.

In other words, we have considered, only, the problem of "straight cable splicing"—where the cables are of the same size (as to pair capacity) and of the same gauge. It frequently happens, however, that the sizes of cables are changed at the splicing points and that one or more branch cables are distributed from the main underground feeder cable.

In such cases—cases where size of cable is varied or where branch distributing cables are spliced to the main cable—it is necessary to evolve additional unit costs to cover the special conditions encountered. The additional cost of the branch, or lateral, cable splices over and above the cost of "straight splicing" may be computed in tabular form and the resultant data so arranged as to be available for unit cost purposes.

It is out of the question to prescribe detailed methods of evolving these special splicing costs—due to the fact that so many widely varying conditions are encountered in the average telephone plant. The engineer in charge of the appraisal should make a careful study of the conditions existent in the plant under appraisement and should evolve unit costs suitable for the case in hand. To give a general idea of the method of tabulating the additional cost of branch splices—over and above the cost of straight splices—the form illustrated in Fig. 26 is presented.

Subsidiary, or Lateral, Cable Unit Costs.—The general method adopted in building up the unit costs for subsidiary, or lateral, cables is identical with the methods already described for evolving underground cable costs. In other words, if the analysis period covers five years—average material costs and average labor costs will be determined; to the material costs there will be added an allowance for waste and loss and to the labor costs there will be added an allowance for direct supervision.

As in the case of the unit costs previously discussed—it is customary to allow approximately 2 percent to cover waste and loss (as applied against the material totals) and approximately 15 percent to cover direct supervision—as applied against the labor totals.

In the case of the lateral cables, however, it will usually be found that the unit cost per foot is higher than the unit cost per foot of corresponding sizes of underground cable. The reason for this will be apparent, when it is remembered that the lateral ducts usually include one or more bends and that it is nearly always necessary to pull the cable thru a bend at the point where the conduit terminates at a building wall or pole.

Splice	Add for Each Additional Leg	Add for Each 25 Pairs	Total Additional Cost
400-200-200			
400-400-200			
200-200- 25			
200-200- 25			
200-175- 25-25			
175- 50- 50-25			
400-200-200			
400-400-100			
400-200-200			
200-200- 50-50			
200-200- 50			
200-150- 25			
400-400-100-50			
150-125- 25			
400-400- 50			
400-400- 25			
400-200- 25			

Fig. 26—Method of Building Up Branch Cable Unit Costs.

Where the subsidiary, or lateral, cables terminate directly in a cable box—this box is included as a part of the exchange underground cable Account No. 245, under the system of accounts as prescribed by the Interstate Commerce Commission. In such cases it will, of course, be necessary to evolve suitable unit costs to cover the placing of the boxes on the poles and, furthermore, to provide for the cost of splicing the "cable legs" attached to such boxes to the lateral cables.

It will not be necessary to discuss the lateral cable unit costs, or the underground terminal unit costs, in detail, in view of the fact that the general method is analagous to the methods we have already considered.

Interior Block Cables.—Within city blocks, where cables are placed along rear building walls or fences, the cost of these cables, it will be remembered, is also chargeable to Account No. 245. The unit costs, however, for interior block cables are appreciably higher than the unit costs for corresponding sizes of either lateral or underground cables. This is due to the fact that the cables must be attached to rear building walls or fences at regular intervals.

If the cable is attached to a brick, concrete, or stone wall, it is customary to drill holes at intervals of from 18 inches to 24 inches and to insert expansion bolts in these holes, the expansion bolts being fitted with a suitable clamp for holding the cable in place. Obviously the process of installing cables in this manner is a laborious and costly one.

If the cables are attached to fences, a suitable clamp can be attached directly to the fence—at a somewhat lower cost than the cost involved in making attachments to building walls. These clamps, however, must be placed at intervals of from 18 inches to 24 inches and the cable so placed on the fence as to minimize the danger of mechanical injury.

*Mr. McKay heads the organization of Charles W. McKay and Associates, Consulting Engineers, 646 North Michigan Avenue, Chicago.

It is also true that additional costs are frequently incurred due to the necessity of making detours to avoid obstructions. In placing a block cable along a rear building wall, it is rarely possible to make a horizontal run thruout the entire block. At intervals, it becomes necessary to raise the height of the cable—in other words, to extend it vertically up the building walls—to provide for the crossing of court yards and so forth. In making such detours it is usually necessary for the men to use ladders to reach otherwise inaccessible places—and, obviously, all of these factors tend to increase the unit cost per foot of cable placed.

The unit costs for interior block cable work may be derived in a manner similar to that employed for underground and subsidiary cables — after taking into consideration the numerous special factors above enumerated. The resultant unit costs (per foot) of cables in place may be three or four times higher than the unit costs for corresponding sizes of underground cables in conduit.

Fortunately, however, in the smaller towns and cities, the interior block cable mode of distribution is limited to a comparatively small area — usually the area encompassed within the boundaries of the commercial, or business, section of the town. In many cases where the topography of city blocks is similar, it is possible to evolve a unit cost per city block which may be applied to a number of blocks. Such a unit cost, when made by an experienced appraisal engineer, will be sufficiently accurate for ordinary purposes.

House Cable Unit Costs.—As previously suggested, there are two types of house (or building) cables—the cables used for providing distribution facilities for office buildings and the cables used for providing telephone facilities for apartment and hotel buildings. The unit costs of house cables are very largely dependent upon the class and type of building.

The unit cost per foot of a house cable system in a modern, well equipped office building will be much lower than the unit cost per foot of a similar system installed in an old office building. It is also true that the same general comments apply to the installation of cables in hotel and apartment buildings. The placing of cables in many of the older buildings necessitates the drilling of building walls at frequent intervals; the "fishing" of cables underneath floors and even, in some cases, the cutting of slots or channels in building walls.

Obviously, the installation of a house cable system under such conditions is a costly process as compared with the cost of installing a similar cable system in a modern building where adequate facilities have been provided by the building engineers and architects.

The appraisement of house cables is, at best, a difficult problem—due to the fact that much of the cabling is concealed. It is usually possible, however, to obtain accurate records from the office of the operating company. These records may be checked, or verified, in the field in sufficient detail to insure their general accuracy and unit costs evolved, which will be suitable.

Central Office Cable Costs.—It will be remembered that the portion of the underground cable within the central office building — extending from the pothead splices to the main frames—is chargeable to the 245 account. Obviously, the cost per foot for short lengths of a given size of cable will be much higher than the cost per foot of longer lengths. Most of the central office terminating cables are of comparatively short lengths — and especial unit costs must be evolved for appraising this portion of the underground cable plant. Another factor which tends to increase the cost per foot of central office terminating cable (and a factor which also necessitates the evolution of separate unit costs) is that these cables are especially designed—as to insulation. The insulation is either of silk and cotton or of wool. In Fig. 27 a method of evolving central office terminating cable unit costs is outlined. It will be noted that costs are first derived per unit of cable as installed and subsequently reduced to a unit cost per lineal foot.

Silk and Cotton Lead Covered Cable	Costs
25 pair No. 22 gauge:	
8 foot cable at —— per foot	.....
Miscellaneous material	.....
Total	.....
2 per cent loss and waste	.....
Total material	.....
Total labor	.....
Total cost	.....
Unit cost per foot	.....
50 pair No. 22 gauge:	
10 foot cable at —— per foot	.....
Miscellaneous material	.....
Total	.....
2 per cent loss and waste	.....
Total material	.....
Total labor	.....
Total cost	.....
Unit cost per foot	.....
200 pair No. 22 gauge:	
12 foot cable at —— per foot	.....
Miscellaneous material	.....
Total	.....
2 per cent loss and waste	.....
Total material	.....
Total labor	.....
Total cost	.....
Unit cost per foot	.....

Fig. 27—Method of Deriving Unit Costs for Central Office Terminating Cables.

We have now practically completed our discussion of the subjects of Underground Cable Unit Costs and of Aerial Cable Costs. As suggested in a previous installment of this series, the aerial and underground cable costs have been discussed in the same general section of this series, due to the fact that there are many similar points involved in the methods of deriving the various component items of unit cost.

We will now consider the general subject of Underground Conduit Costs —the unit costs involved in the appraisement of property falling under Account No. 244, as prescribed by the Interstate Commerce Commission's system of accounts.

To review the instructions, as prescribed by the Commission—"the cost of service conduits, including cost of pipe, cement, manholes and all other materials used, the cost of connecting to poles and buildings, repaving and other costs incident to the installation of such conduits" shall be chargeable to the underground conduit accounts. All exchange construction is chargeable to Account No. 244 and toll construction to Account No. 254.

We may divide the conduit system into three major subdivisions—for the purpose of deriving unit costs. These subdivisions are:

1—Main conduit—in other words, the conduit between manholes.
2—Lateral or subsidiary conduits—in other words, branch conduit extending from manholes to poles of buildings.
3—Manholes.

Main Conduit.—As previously suggested, the underground conduit system constitutes one of the most important items of a telephone system—from the standpoint of telephone property evaluation.

Quite naturally, the subdivision of the underground conduit system listed under the caption "Main Conduit" is the most important—in view of the fact that it represents the largest investment and, furthermore, (speaking from the standpoint of the appraisal engineer) the main conduit system of any telephone property presents many difficult problems—both as to the inventory and as to the appraisement.

Fig. 28 presents an illustration of the method of computing main conduit unit costs.

Referring to the illustration—column No. 1 provides for the recording of data relative to the size and type of conduit under consideration. Under column No. 2, should be entered the figures representing the excavation—expressed in cubic yards per trench

foot. Under column No. 3, should be listed the amounts of concrete and mortar (mortar for joining the individual sections of clay tile). Column No. 4 provides for the listing of cost of tile and miscellaneous material per trench foot.

The figures incorporated in column No. 4 should be based upon five year average unit cost studies, as applied to the quantities expressed in columns No. 3 and No. 4.

Column No. 5 covers the cost of actual excavation; backfilling and carting (the excess dirt away from the excavation) expressed in a unit cost per trench foot. Under column No. 6 should be listed the cost of the concrete—expressed in terms of a unit cost per trench foot. Column No. 7 provides space for the unit labor costs involved in laying and distributing the conduit and column No. 8 provides for the unit costs per trench foot of carting tile, concrete and miscellaneous material.

At the bottom of the figure it will be noted an explanation is given of the method of arriving at the trench foot figures to be inserted in columns 4 to 8 inclusive.

Column No. 9 gives the total cost per trench foot of the various sizes of conduit—the figures being determined by adding the component costs as given in columns 4 to 8 inclusive.

In column No. 10, the cost per trench foot is reduced to a cost per duct foot. The figures presented in column No. 10 should not be used for appraisal purposes—but they are often convenient for use in checking the unit costs as summarized in column No. 9.

The unit costs resultant from the analysis illustrated in Fig. 28, should be plotted in curve form. In this way, it is possible to make comparisons with other unit costs and, furthermore, it is possible to interpolate to obtain the cost of sizes of conduits intermediate to those given in column No. 1 of the table.

To illustrate—if the procedure outlined above is adopted, it is possible to obtain a definite unit cost for a 20-duct subway and also a unit cost for a 28-duct subway. If we desire to obtain costs for odd sizes of subway, falling between these two (for instance in 22-duct, 24-duct, 25-duct and so forth), we may refer to the curve and obtain a direct reading which will be sufficiently accurate for ordinary purposes.

Lateral Conduit.—Unit costs for lateral conduits may be built up in practically the same manner as above outlined in connection with the main conduit. Five-year average material and labor costs should be obtained (always assuming that our analysis period is limited to five years) and the resultant figures properly incorporated in the unit costs. In connection with the lateral conduit an especial feature is presented, that of the so-called "risers." In addition to the cost of the conduit between the manhole and the pole or building, we have also the cost of terminating the lateral at the pole or building. These terminal facilities are known as "risers"—and usually consist of three-inch iron pipe bends. Sometimes, however, fibre conduit or clay tile is used for risers.

Length of Riser	3" Pipe Bends	Vertical Pipe	Labor	Total Cost
.....	.....	.....	.....	.....
5 ft.	.....	.....	.....	.....
10 ft.	.....	.....	.....	.....
15 ft.	.....	.....	.....	.....
20 ft.	.....	.....	.....	.....
25 ft.	.....	.....	.....	.....

3-inch Iron pipe, —— per ft.
3-inch Bends, —— each.

Fig. 29—Illustrating Method of Deriving Unit Costs for Risers.

An illustration of the method of deriving riser unit costs is presented in Fig. 29.

Fig. 30 presents an excellent cross-sectional illustration, showing the exact relation of the riser to the lateral conduit.

The illustration in Fig. 29 should prove self-explanatory—the method being essentially the same as the methods referred to in connection with previous unit costs.

Manholes.—Generally speaking, there are two types of manholes used by telephone companies—concrete manholes and brick manholes. A method which the writer has frequently used in evaluating manholes is based upon a valuation made, a good many years ago, of the property of the Chicago Telephone Co., now the Illinois Bell Telephone Co. This method is predicated upon the assumption that a basic charge, or cost, may be derived which will include the cost of manhole covers and other similar items common to all sizes and classifications of manholes.

The basic charge may range from $25 to $100 (or more) per manhole, dependent upon the exigencies of the case under consideration. After the basic charge has been determined, the cubical contents of the manhole is computed and the resultant figure multiplied by a unit cost per cubic foot.

The foregoing method may sound rather theoretical but it has an intensely practical value. It has been tried in connection with the evaluation of telephone properties all over the country and proven most satisfactory. The successful application of the method, however, must be predicated upon a careful determination of the basic charge and also of the charge per cubic foot. If a given number of manholes are appraised in detail—making careful allowance for all of the material and labor items involved—certain standards may be obtained

STUDY OF SUBWAY COSTS
Exclusive of Manholes and Repaving. Complete Concrete Envelope.

No. of Ducts Col. 1	Cu. Yds. Excavation per Tr. Ft. Col. 2	Cu. Yds. Concrete and Mortar per Tr. Ft. Col. 3	Cost Tile and Miscellaneous Material per Tr. Ft. Col. 4	Cost Excavating and Backfilling and Hauling Excess Dirt Col. 5	Cost Concrete in Place Col. 6	Labor Laying and Distributing Tile Col. 7	Hauling Tile and Concrete Material Col. 8	Total per Tr. Ft. Col. 9	Total per Duct Ft. Col. 10
2	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....

NOTE: These results were plotted on curve to obtain interpolations for intermediate sizes.
Col. 4—Tile and miscellaneous material —— per duct foot.
Col. 2—Excavating, backfilling and hauling excess dirt @—— per cubic yard of excavation.
Col. 6—Concrete and mortar in place —— per cubic yard.
Col. 7—Labor distributing and laying tile @ —— per duct foot.
Col. 8—Hauling tile and concrete material @ —— per duct foot.

Fig. 28—Form for Compiling Subway Costs.

which will serve as a basis for determining the proper basic charges and proper charges per cubic foot.

There is still another item to be considered in connection with the evaluation of a telephone conduit system—the cost of repaving. Telephone subways are frequently laid in paved streets and the cost of removing and replacing the surface pavement, obviously, is a factor to be considered in determining the cost of the property, regardless of whether such cost is being obtained on a reproduction or original cost basis. However, paving costs are almost entirely dependent upon local conditions—certain schedules of the cost of repaving being available, either thru City Engineers or thru local contractors.

In the April issue central office and subscribers' station equipment unit costs will be discussed.

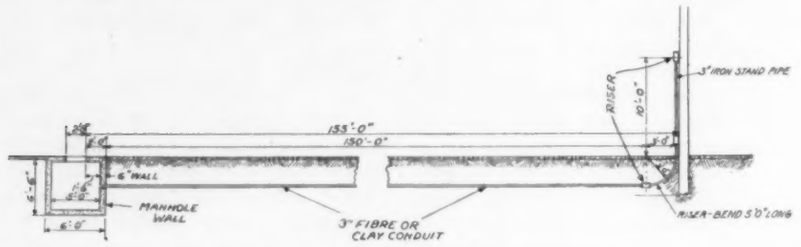


Fig. 30—Showing Relation of Riser to Lateral Conduit

Change Needed in Our Immigration Laws, Says Thomas

At the 27th annual meeting of the Northern White Cedar Association at Minneapolis, Minn., January 30 and 31 officers elected were: M. H. Schussler, Minneapolis, president; E. N. Whyte, Curry & Whyte Co., Duluth, vice-president; H. F. Partridge, T. M. Partridge Lumber Co., treasurer; W. C. Meader, Bell Lumber Co., Minneapolis, and W. H. Gilkey, Pendleton & Gilkey, Minneapolis, directors for two years. N. E. Boucher, Minneapolis, was re-elected secretary. Retiring Pres. Thomas, in his address, said that the immigration restrictions now in effect need modification if we are to have labor adequate for the development of the country. The problem, he said, is that of selection. The desirable immigrant is he who, regardless of race or language, has within him the spirit of individualism on which this country was founded. The secretary's office distributed a comparative statement of strength of poles of northern white cedar, western red cedar and southern pine, which was favorably received.

Business Doubles, Formal Demand for "Relief"

Atlanta, Ga.—Stating that telephone company receipts in Atlanta were $2,000,000 in 1922, "an increase of 100 per cent over previous years," R. C. Turner, city electrician, has made a formal demand on the public service commission for "immediate relief" in the matter of telephone service and rates.

Four Northern Texas Telephone Companies Merged

Waco, Tex.—J. B. Earle, president of the Texas Toll Line Co., has secured the controlling interest in four telephone companies operating in northern Texas. The companies acquired are the Grayson County Telephone Co., of Sherman and Howe; the People's Home Telephone Co., of Denton; the North Texas Telephone Co., with exchanges in Whitesboro, Collinsville, Tioga and Pilot Point, and the Bonham Telephone Co. Mr. Earle is president of the Liberty National Bank, of Waco.

Estimate Gives Texas 90,000 New 'Phones in 5 Years

Dallas, Tex.—F. M. Hogg, general manager for the Southwestern Bell Telephone Co. in Texas, estimates that 90,000 new telephones will be added to the Texas service in the next five years. This estimate, he says, is based on the expected increase in population.

COMING STATE CONVENTIONS

Texas, Hotel Adolphus, Dallas, March 20-23.

Wisconsin, Wisconsin Hotel, Milwaukee, March 21-23.

Florida, Roberts Hotel, Miami, March 27-28.

New York Up-State, Powers Hotel, Rochester, April 18-20.

Iowa, Ft. Des Moines Hotel, Des Moines, April 24-26.

NEBRASKA CONVENTION

Favorable Record Helps Telephone Financing—Federal Tax on Toll Calls Put Up to Customers

At Lincoln, February 22, the Nebraska Telephone Ass'n elected the following officers: President, C. L. Kelly, of North Bend; vice-presidents, E. D. Warner, Scottsbluff, and J. W. Richmond, Wisner; secretary-treasurer, A. W. Forbes, Stanton. The directors are: Lloyd B. Wilson, Omaha; R. E. Mattison, Lincoln; George E. Becker, Pawnee City; Warren Pratt, Kearney; D. E. McGregor, Kellogg Switchboard & Supply Co.; M. D. Young, Franklin; J. E. Grint, Sargent, and E. B. Wait, Comstock. Chas. A. Randall, of the Nebraska Railway Commission, illustrated by charts the sharpness of the deflation that had occurred in agriculture, and said that in part telephone rate increases were asked for at a time when farmers and business men were being pinched. He declared that if the people could see his charts, showing the facts, they would not damn the commission for doing its duty or criticise telephone companies for asking for higher rates. Eben D. Warner, of the Platte Valley Telephone Co., said his experiences had proved that if a company could show its public relations were favorable; that it had a good financial history, and that the proper physical property was there, re-financing always was possible.

A. J. Cole of the Platte Valley Power Co., said the Nebraska joint committee on physical relations between electric supply and signal lines makes it easier for the telephone man because he can say to his board that what was decided upon was not his idea but the verdict of a jury of experts. Speedy decisions are made by the committee. The resolutions committee reported on the federal tax on toll calls that as this is a tax paid by the customer, any agitation for repeal should come from him.

United States Leads the World in Telephones

United States has 63.92 per cent of the world's telephones; Germany, 8.6 per cent; Great Britain, 4.73 per cent; Canada, 4.11 per cent; France, 2.27 per cent; Sweden, 1.86 per cent; Japan, 1.59 per cent; Denmark, 1.21 per cent. The United States has 12.4 telephones for each 100 population. There are 32,000,000 miles of telephone wire in the United States or 60.77 per cent of all the wire in the world.

Extensions Out of Earnings

Financing and Good Business Judgment Discussed by the Editor—Little "Water" in Financial Structure of the Telephone Industry—Ideas for Health

By R. V. Achatz

In the business world it is considered to be a safe and conservative financial policy to reserve a portion of the earnings of a corporation to be invested in extensions and improvements if the business is of a type which is expected to be continued indefinitely. A reasonable amount of surplus earnings invested in the business is considered to be one of the marks of a concern which is on a sound financial basis.

While this policy is to be commended, yet it is possible that it can be carried too far. Good business sense does not demand that all of the earnings be reinvested nor does it require that the financing of extensions in a growing plant be made entirely of earnings.

One of the elements of the financial strength of the American Telephone & Telegraph Co. is the value of its property is considerably in excess of its capital obligations, due to a long continued policy of investment of a portion of its surplus. One of the financial weaknesses of many companies outside the Bell group is the fact that this policy has been carried to an extreme.

There is little "water" in the financial structure of the telephone industry. It is undercapitalized rather than overcapitalized. For every company that has outstanding stocks and bonds in excess of the value of its property, there are many that have an investment so much in excess of capitalization that it constitutes a real financial handicap.

Many of the locally owned telephone companies started in the days of the rapid expansion of the Independent side of the business with a small amount of capital stock subscribed and paid for. As the business grew, instead of being paid out in dividends, the earnings were used for extensions until today a large property has been built up, almost without the investment of new capital beyond the earnings that the stockholders have voluntarily allowed to remain in the business.

There are many of the medium sized telephone companies that have property valued at from three to ten or more times the par value of the outstanding capital obligations, and this is the cause of a difficult problem of financial management. The market for the outstanding stock is destroyed, as investors do not care to pay a large amount in excess of the nominal par value.

Dividends based on a reasonable valuation of the stockholders' holdings appear to be excessive when expressed as a percent upon the par value of the stock. New stock can not be sold at or near par where it is attractive to prospective purchasers without injustice to the old stockholders. From the standpoint of the stockholders and the company, the entire situation is undesirable.

In some cases the expansion of the property has been limited by the amount of surplus earnings available for investment in the property. In many such cases, the growth of the plant has been strangled and inadequate plant and service has resulted. This is undesirable from the standpoint of the community served, as well as from the standpoint of the company itself. The telephone property of the country would never have reached its present development if it had depended on its own earnings for growth.

The laws regulating public utilities in most states assume that there is reasonable agreement between outstanding capital obligations and property value. The problem of rate making is sometimes simplified if this is the case. In fact, present conditions in the utility field demand that the value of the property be represented in a fairly accurate way by the amount of stock in the hands of the owners, less, of course, any other securities that may have been issued.

Whether it is practicable for every company where this is not the case to make a readjustment of its capital account, depends much upon local conditions and upon the laws of the state in which it operates. In any case, the practice of returning the earnings directly to the property should be abandoned where the value of the property is too greatly in excess of the capitalization.

Dividends should be declared and if the money is necessary in this plant, new stock should be issued and paid for by the stockholders out of the funds received as dividends. When this policy is adopted, and when all companies that are not earning a return on the investment see to it that their rates are adjusted to a point where they do, the telephone industry will be in a much healthier condition financially.

Telephone Papers Are Presented on an A. I. E. E. Program

New York, N. Y.—A number of technical papers relating to telephone practice and allied subjects were presented at the Eleventh Mid-winter Convention of the American Institute of Electrical Engineers. Among the strictly telephone papers were those on "Telephone Transmission over Long Cables," by A. B. Clark of the Engineering Department of the American Tel. and Tel. Co. and on "Machine Switching," by E. B. Craft, Chief Engineer of the Western Electric Company and H. P. Charlesworth, Plant Engineer of the American Tel. & Tel. Co. A paper of interest from the construction side was "Wind Shielding Between Conductors," by P. J. Howe, construction engineer of the Western Union Telegraph Co. Among the other papers were two papers on the Public Address System, one by I. W. Green and J. P. Maxfield and the other by W. H. Martin, a paper on the "Theory of Electric Filter Circuits," by L. J. Peters, Electrical Laboratories, University of Wisconsin, and two papers on Radio subjects, "Wave Antenna," by H. H. Beverage, Chester W. Rice and Edward W. Kellogg, all of the General Electric Co., and "Diaphragmless Microphone for Radio Broadcasting," by Phillips Thomas, of the Westinghouse Electric and Mfg. Co. A paper by Aram Boyajian on "Physical Interpretation of Complex Angles and Their Functions," deals with a subject of importance to those who are studying the mathematical side of telephone transmission.

PROTECTOR STRIPS
For Pole House Mounting

No. 927

Line includes strips with and without lightning arresters for small and large cables.

FUSE CLIPS that bite through corrosion to the clean metal.

Reliable Electric Company

3145 Carroll Avenue :: CHICAGO, ILL.

New England T. & T. Construction in '22 Was $23,400,000

Boston, Mass.—The New England Telephone & Telegraph Co., in its report, shows that it paid out for construction in 1922 the sum of $23,400,000. The report also shows that the great sleet storm of 1921 cost the company about $2,000,000. Installations reported show a gain of 70,046 telephones in 1922.

Boston, Mass.—The Southern New England Telephone Co. reports net after taxes and other charges of $1,429,652 for 1922 as compared to $1,290,628 in 1921.

Charleston, W. Va.—Henry Moore, of Big Isaac, has purchased the People's Telephone Co. of Doddridge county, at receiver's sale.

Pawhuska, Okla.—The West Telephone Co., capital $5,000, has been organized here by B. E. Quimby and others.

Spencer, Ia.—The Summit Center Telephone Co. is being organized here. G. H. Schoeneman is president.

Corcoran, Cal.—The Corcoran Telephone Co., capital $25,000, has been organized here.

Illinois Bell Telephone Co. in Better Situation

Chicago, Ill.—The annual report of the Illinois Bell Telephone Co. for the year ending Dec. 31, shows a net income of $6,353,628 as compared to $5,625,951 in 1921. This is equivalent to $10.59 a share on the $60,000,000 outstanding capital stock as against $11.25 on the $50,000,000 outstanding stock reported in 1921. After providing for $4,000,000 dividends the company reports a surplus for the year of $2,353,628 as compared to $2,025,951 in 1921.

Anyway, They Got Out of Court Alive

The Louisiana compromise, recently brought about between the Cumberland company and representatives of the public, doesn't give either side what was wanted. All hands, however, including a rather bitter newspaper press, seem to think that a compromise is better than a doubtful and prolonged lawsuit.

Litigation is usually costly and undesirable. Doubtless settlement, though not sweet, is better than a bitter feud. However, there are times when fights must go on to the end.

'Phone Service on Pacific Coast Is Extending Fast

Oakland, Cal.—The Pacific Telephone & Telegraph Co. installed 5,500 telephones in the "eastbay" district, which includes Oakland and Berkeley, in 1923. The improvements, according to a company announcement, cost $898,000. In the last three years 16,505 phones have been added in the district.

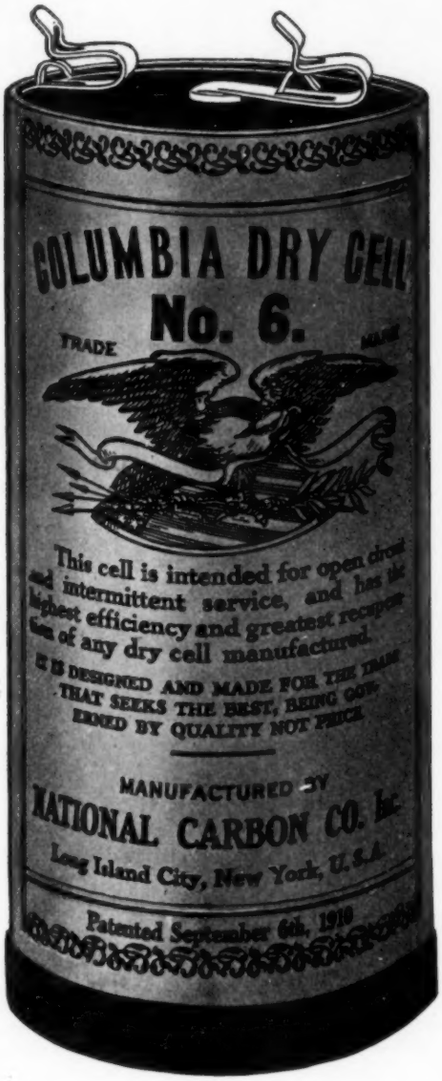
Gulfport, Miss.—A. M. Fishburn, local manager of the Cumberland company, has been elected president of the Harrison County chamber of commerce.

Eldora, Ia.—The Eldora Telephone Co., capital $61,200, has been organized here with Thomas Larson president.

Visalia, Cal.—H. P. Harrolson, of Visalia, has been granted a permit to build a telephone line from Dinuba to General Grant Park.

Kerrville, Tex.—Capital stock of the Kerrville Telephone Co. has been increased from $30,000 to $60,000.

Seaton, Ill.—The Logan Telephone Co., capital $10,000, has been organized here by F. L. Logan and others.


COLUMBIA DRY CELL
No. 6.
TRADE
This cell is intended for open circuit intermittent service, and has the highest efficiency and greatest recuperation of any dry cell manufactured.
IT IS DESIGNED AND MADE FOR THE TRADE THAT SEEKS THE BEST, BEING GOVERNED BY QUALITY NOT PRICE
MANUFACTURED BY
NATIONAL CARBON CO. Inc.
Long Island City, New York, U.S.A.
Patented September 6th, 1910

Columbia Telephone Batteries are unlike humans—these Gray Labels, for example, eat only while they work. While the receiver's hung up, they quit. The net result is that they conserve their stock of food—and cost less per month of service. Fahnestock Spring Clip Binding Posts at no extra charge.

NATIONAL CARBON COMPANY, INC.
Long Island City, N. Y.

Atlanta Chicago Cleveland
Kansas City San Francisco

Columbia Telephone Batteries

"less cost per month of service"

WIRE TABLES (HH-10-20)
CARRYING CAPACITY OF WIRES

NATIONAL ELECTRIC CODE. In the following tables will be found the current carrying capacities for electrical wires using various insulations as required by the National Electric Code. This covers all wires used for interior wiring. Temperature rise from General Electric data (Max. Current).

CARRYING CAPACITY OF SOLID COPPER WIRES

B & S Gauge No.	Area in Circular Mils	Capacity in Amperes for Rubber Cover	Capacity in Amperes for Weather-proof	Amperes Per 30° C. Temp. Rise	Amperes Per 50° C. Temp. Rise
18	1,624	3	5	...	...
16	2,583	6	8	...	...
14	4,107	12	16	...	...
12	6,530	17	23	...	...
10	10,380	24	32	...	...
8	16,510	33	46	...	...
6	26,250	46	65	61	76
5	33,100	54	77	75	93
4	41,740	65	92	85	104
3	52,630	76	110	108	131
2	66,370	90	131	133	162
1	83,690	107	156	155	189
0	105,500	127	185	191	231
00	133,100	150	220	218	268
000	167,800	177	262	266	325
0000	211,600	210	312	320	391

CIRCULAR MIL SIZES SOLID COPPER WIRES

Area in Circular Mils	Capacity in Amperes for Rubber Cover	Capacity in Amperes for Weather-proof	Amperes Per 30° C. Rise	Amperes Per 30° C. Temp. Rise
200,000	200	300		...
300,000	270	400	414	506
400,000	330	500	512	626
500,000	390	590	606	742
600,000	450	680	694	848
700,000	500	760	...	...
800,000	550	840	...	...
900,000	600	920	940	1,149
1,000,000	650	1,000	1,017	1,333
1,100,000	690	1,080	.....	.....
1,200,000	730	1,150	1,188	1,408
1,300,000	770	1,220	.....	.....
1,400,000	810	1,290	.....	.....
1,500,000	850	1,360	1,376	1,644
2,000,000	1,050	1,670	1,766	2,178

For insulated aluminum wires, the capacity will be 84 per cent of the capacities given above by the National Code for copper wire. The temperature rise for the various conductors was experimentally determined for the rubber covered braided wires commonly used in practice. By examining the tables it will be seen that the number of amperes required for a temperature rise of 30° C. very closely corresponds to the National Code requirements for a rubber covered copper conductor.

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HH—10—21

WIRE TABLES (HH-10-21)
CARRYING CAPACITY OF CABLES

National Code for Cables. The following data on cables or stranded conductors gives the carrying capacity in amperes according to the National Electric Code, the actual area of the commercial cables in circular mils, the number of strands and the gauge number of the strand. This is for copper wires. For aluminum wire the safe current capacity is 84 per cent of that given for the copper wire. Values are for interior wiring.

CARRYING CAPACITY OF STRANDED COPPER CONDUCTORS

B & S Gauge No.	Actual Area Circ. Mils	No. of Strands	Size of Strands B. & S. G.	Safe Current Amperes
18	1,624	...	..	...
17	2,048	...	..	...
16	2,583	...	..	...
15	3,257	...	..	6
14	4,107	...	..	...
12	6,530	...	..	12
..	.....	...	..	17
**	9,016	7	19	21
**	11,368	7	18	25
**	14,336	7	17	30
**	18,081	7	16	35
**	22,799	7	15	40
**	30,856	19	18	50
**	38,912	19	17	60
**	49,077	19	16	70
**	60,088	37	18	85
**	75,776	37	17	100
**	99,064	61	18	120
**	124,928	61	17	145
**	157,563	61	16	170
**	198,677	61	15	200
**	250,527	61	14	235
**	296,387	91	15	270
**	373,737	91	14	320
**	413,639	127	15	340

Capacity of Lead Covered Cables. The current capacity of stranded copper cables sheathed with lead, depends upon a number of factors.

1. The size and number of conductors.
2. Their relative position.
3. The thermal conductivity of the insulation and sheath.
4. The ability of the insulation to withstand high temperatures.
5. The thickness of the insulation and sheath.
6. The temperature of the surrounding air.
7. The Nature of surrounding air currents.
8. The form and proximity of objects near the cables.
9. The number of cables bunched together.

When there is more than one conductor included under one sheath, running at different temperatures and current densities, there is an interchange of heat between the conductors which may influence the total operating temperature of the cable. Each conductor of a cable with a number of conductors will have a smaller current capacity than a single conductor of the same size.

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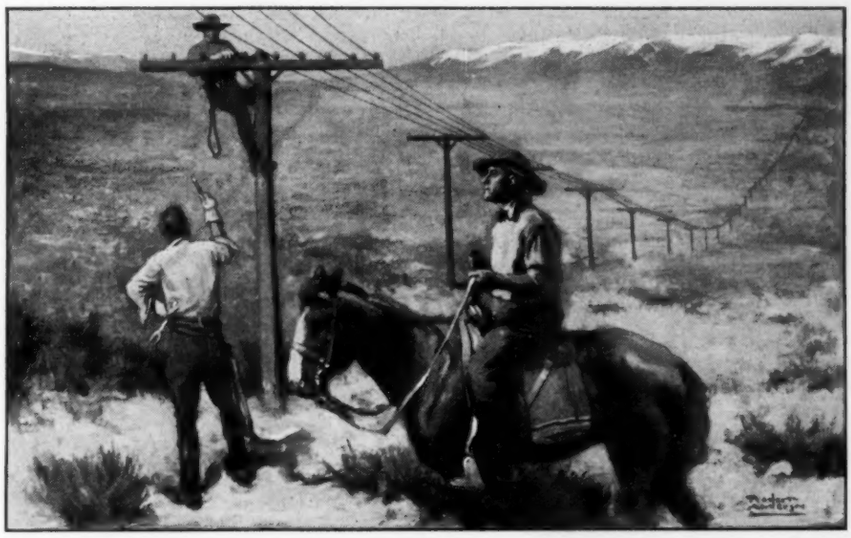

The Bell System's transcontinental telephone line crossing Nevada.

Highways of Speech

Necessity made the United States a nation of pioneers. Development came to us only by conquering the wilderness. For a hundred and fifty years we have been clearing farms and rearing communities where desolation was—bridging rivers and making roads—reaching out, step by step, to civilize three million square miles of country. One of the results has been the scattering of families in many places—the separation of parents and children, of brother and brother, by great distances.

To-day, millions of us live and make our success in places far from those where we were born, and even those of us who have remained in one place have relatives and friends who are scattered in other parts.

Again, business and industry have done what families have done—they have spread to many places and made connections in still other places.

Obviously, this has promoted a national community of every-day interest which characterizes no other nation in the world. It has given the people of the whole country the same kind, if not the same degree, of interest in one another as the people of a single city have. It has made necessary facilities of national communication which keep us in touch with the whole country and not just our own part of it.

The only telephone service which can fully serve the needs of the nation is one which brings all of the people within sound of one another's voices.

"BELL SYSTEM"
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
One Policy, One System, Universal Service, and all directed toward Better Service

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ALTERNATING CURRENTS (EE-9-25)
SKIN EFFECT IN CONDUCTORS

Elements of Skin Effect. When an alternating current passes through a conductor, the current density is unequally distributed, the current being heaviest near the external surface or "Skin" of the conductor and decreasing in density as the center is approached. With large wires the central portion of the conductor is nearly useless as a conductor, and as the effective area of the wire is thus reduced, its resistance is increased and its carrying capacity is diminished. The carrying capacity of such a wire is far below its capacity when carrying a direct current. This is called "Skin Effect."

To obtain the least skin effect for a given weight of conductor it is therefore advisable to increase the superficial area of the wire and to decrease the cross-sectional area of the metal near the center. As a stranded cable has a greater superficial area than a solid wire of circular cross-section, the cable gives greater carrying capacity and less resistance than the solid conductor. In high frequency work, where losses by skin effect are very high, this idea is carried further by employing flat metal strip, square wire or "Litzendraht" cable, the last consisting of a stranded cable built up of wires, each strand being covered with enamel insulation so that it acts as an independent conductor and therefore enormously increases the effective superficial area. A hollow tube or hollow wire offers less resistance per pound foot than a solid conductor, and as a triangular section has greater outside area per outside measurement than any other geometric form it is almost an ideal form for very high frequency currents.

The skin effect increases with the frequency and the diameter of the wire (Squared), the loss being very small for ordinary power frequencies of 25 cycles per second,larger for 60 cycles per second and still larger for 133 cycles. With frequencies above 1,000 cycles per second the current lies mostly in the skin of the conductor. A large number of small wires is more economical from this standpoint than a large single conductor of equivalent cross-sectional area. The effect increases with the square of the conductor diameter, and the complete relation may be expressed by:

$$\text{Frequency} \times \text{Diameter}^2 = \text{Constant}$$

The following table contains convenient factors for computing the skin effect at the usual frequency employed in commercial circuits, the factors taking the frequency and diameter into account:

SKIN EFFECT FACTORS

A =	25.00	35.00	43.00	49.50	56.50	71.50	84.50	96.00
B =	1.02	1.04	1.06	1.08	1.10	1.15	1.20	1.25
A =	108.00	130.50	154.50	178.50	204.00	232.50	263.50	294.00
B =	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00

In this table we have the following values for the factors (A) and (B):

$$A = \text{Diam.}^2 \times \text{Frequency} = \frac{\text{Circular Mils}}{1{,}000{,}000} \times \text{Frequency (Diameter in Inches)}$$

B = Multiplying Factor

To find the factor with which the resistance to the direct current is to be multiplied, in order to obtain the resistance to alternating currents, Multiply the frequency and divide by 1,000,000, then find the result in line (A) between two of the nearest numbers in the table. The required factor on line (B) lies between the factors corresponding to these two numbers, and the exact result is then obtained by interpolation. Example: Find the resistance to an alternating current, 133 cycles per second, 850, circular mils, the cable offering a resistance of 0.001157 ohms to direct current.

$$\frac{\text{Circular Mils} \times \text{Frequency}}{1{,}000{,}000} = 0.85 \times 133 = 113 \text{ (A)}$$

ALTERNATING CURRENTS (EE-9-26)
SKIN EFFECT IN CONDUCTORS (Continued)

Having obtained the value of (A) as 113, we refer to the table where we find that the result lies between 108.0 and 130.5, the difference between the last two amounting to 22.5. This corresponds to a difference in the corresponding (B) factor of 1.40 — 1.30 = 0.10, and since the difference between 113 and 108 is 5, we have by simple proportion:

$$0.1 \times \frac{5}{22.5} = 0.02, \text{ the increase in the factor above 1.30}$$

corresponding to the increase in the numbers in line (A) from 108 to 113, so that the factor corresponding to 113 is: 1.30 + 0.02 = 1.32. Multiplying this by the resistance to the direct current, we have: 0.001157 × 1.32 = 0.001527 ohms as the resistance against alternating current. It should be understood that the above computation holds for solid wires of circular section only and for any other section different factors must be used. The equated resistance found above can be used in connection with formulae on self-induction and capacitance when finding the total resistance, ohmic and inductive.

DIRECT CALCULATION. In cases where the table just given does not cover the desired range of frequencies, the following approximate formula can be applied for the calculation of skin effect.

In this equation r — resistance offered to an alternating current, R = resistance offered to an alternating current, f = frequency in cycles per second, and L = length of the conductor in centimeters.

It will be noted that the reciprocal 1/R is proportional to the cross-sectional area of the conductor as in the first method described. While the cross-sectional area is of importance in skin effect, and must be kept as small as possible in the usual copper or other non-magnetic conductors, particular care must be taken to keep the diameter of magnetic conductors down to the lowest limits. It must be considered seriously in circuits where iron or steel acts as a conductor. Skin effect reaches a high value in iron wire circuits at telephonic frequency.

SKIN THICKNESS. Gray and Lord Kelvin computed the thickness of the skin or "shell" of current in an alternating current circuit, and a few of these values are tabulated below for a few different frequencies, both for copper and for iron conductors. It should be noted how the magnetic material pinches down the effective skin thickness compared with the copper conductor, and how necessary it is in magnetic material to extend the surface as much as possible. This table applies only to solid circular sections.

THICKNESS OF SHELL ON CYLINDRICAL CONDUCTORS

Frequency in Cycles per Sec.	Thickness of Shell in Centimeters	
	Copper	Iron
80	0.719	0.0976
120	0.587	0.0789
160	0.509	0.0691
200	0.455	0.0671

At radio frequencies, ranging from 100,000 to 1,000,000 cycles per second, the current shell is exceeding thin and any little change from a circular cross-section instantly meets with a reduction in resistance losses. For example, the change from a circular No. 14 wire to a square section No. 14 increased the receiving radius of one set by about 50 miles without making any other changes. Very thin flat strip gave even better results, but care had to be exercised so that the capacitance was not greatly increased at the same time.

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EE—9—25
Circular Mils × Frequency / 1,000,000 = 0.85 × 133 = 113 (A)

Experiences of This Kind

Demonstrate the Economy of INTERNATIONAL Creosoted Pine Poles

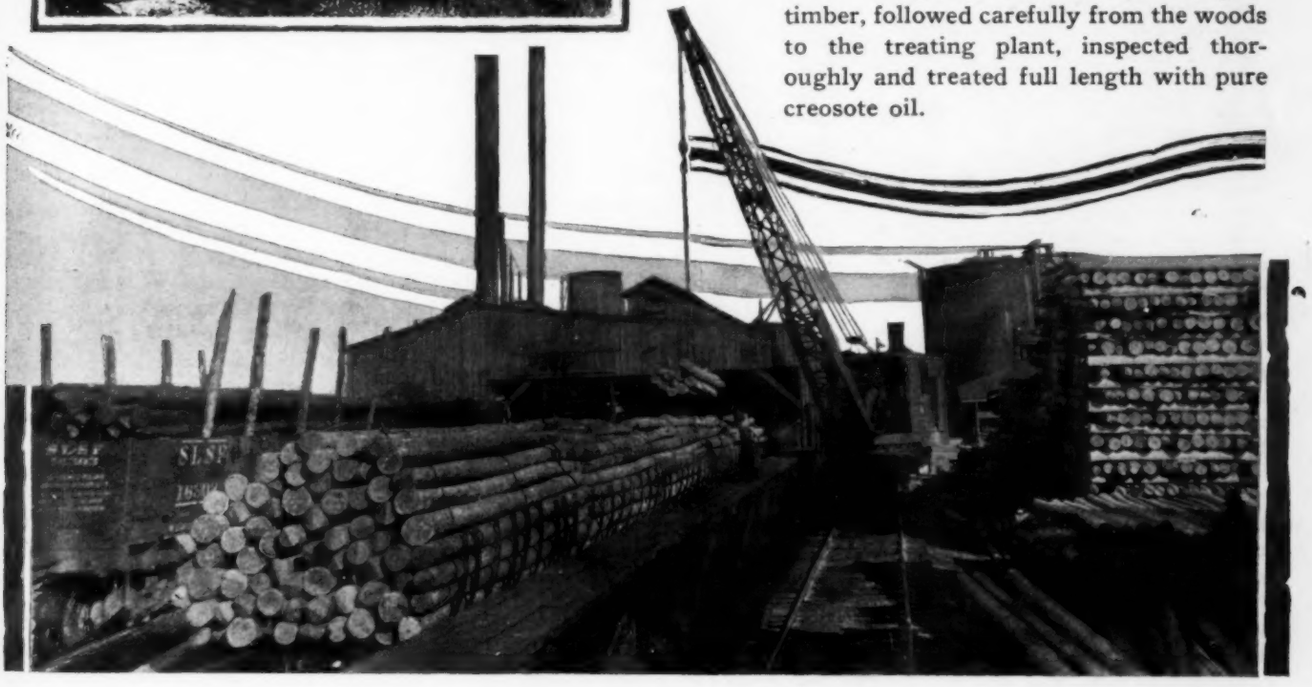
STUDY the illustration at the left. It exemplifies with compelling force the superiority of Creosoted Pine Poles over poles of other species.

The pole with the concreted butt is one of an entire line in which all of the butts had to be concreted after seven years and the entire line was removed after eleven years.

Right next to this line and under exactly the same climatic and soil conditions stands a line of International Creosoted Pine Poles. The record behind these poles is TWENTY-TWO YEARS OF SERVICE AND NO REPLACEMENTS.

This record is not exceptional but representative of all International Products.

International Creosoted Yellow Pine Poles are produced from selected pine timber, followed carefully from the woods to the treating plant, inspected thoroughly and treated full length with pure creosote oil.



International Creosoting & Construction Co.

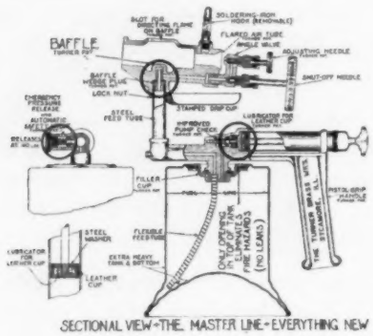
General Office: Galveston, Texas

Plants: Texarkana, Texas Beaumont, Texas Galveston, Texas

TURNER MASTER TORCH

Features Claimed of Interest to Telephone Men

A new blow torch is being marketed by the Turner Brass Works, Sycamore, Ill. Its makers claim it is the only blow torch with a safety valve. This valve is fitted with a diaphragm to give away automatically at 40 lbs. pressure. As torches operate at 18 to 20 lbs. pressure, this valve will not come into action until about double normal pressure is present. A thumb-nut permits the operator to release the air pressure after his work



SECTIONAL VIEW-THE MASTER LINE-EVERYTHING NEW

is done, or to decrease pressure as desired during operation. In this torch there is but one opening in the tank. This is at the top, above the fuel line, and is sealed by the screw-thread filler-plug. Burner inlet and upper and lower pump brackets, frequent causes of leakage-trouble, are removed. The pump leather spreads like a parachute on the work-stroke and, like a parachute, closes on the return stroke. This leather is lubricated from vaseline in the brass washer at the end of the pump rod.

The torch-head plays a "thinking" part in doing its daily work. The fuel, in its journey from tank to combustion chamber, passes through a bronze baffle, called the "Hot Spot Hump." The intense heat vaporizes the fuel into a highly inflammable gas. This accounts for the claim that these torches can burn kerosene or the leanest grade of gasoline, and generate a heat some 400 degrees higher than ordinary torches get from high test gasoline.

Instead of depending upon a multitude of holes in the burner-tube for oxygenation of the fuel, the Turner "Master" torches admit air through a flared inlet in front of the needle valve. The operator can regulate its distance from the needle-valve, and consequently, the volume of air admitted. Air also is admitted through a long slot at the top of the burner tube, immediately above the Hot Spot hump. This deflects the flame downward upon the "hump," and provides additional oxygen to insure complete combustion.

The absence of holes in the sides of the burner tube is cited as one of the reasons why a Turner "Master" torch "can't blow out." To prevent "strong-arm" work at the hand-wheel, the Turner people have separated the shut-off valve from the fuel-control valve, placing the latter above the shut off. For the same reason they have given the needle valve only a small thumb-nut control so as to make it practically impossible for the operator to exert enough pressure to enlarge the orifice. The larger wheel has only one use—that of opening or closing the fuel-line. As its valve has a positive seat, there is never any occasion to use force on this wheel. The "Master" torch has a wooden pistol-grip handle, hung at an angle that balances the torch perfectly, yet gives ample room for the largest hand. The use of a single length of curved steel tubing to carry the fuel from tank to torch eliminates all soldered or threaded joints and connections.

The Master Torch is built in various sizes and types. Wm. F. Pagel, president of Turner Brass Works, considers the "Master" line the most important contribution to modern metal working crafts made by his company in its whole 44 years of torch-building.

To Exporters of Electrical Machinery, Apparatus and Supplies

A new revised edition of the "Glossary of Electrical Terms and Instructions to Exporters" has just been released by the Department of Commerce and should be used by every exporter of electrical materials in the preparation of his export declarations. The price of the "Glossary" is only 5 cents. It may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., or any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce.

Hall Bros. Cedar Co. Moves to Coeur d'Alene, Idaho

Coeur d'Alene, Idaho—The Hall Bros. Cedar Co. has announced that its general offices have been moved from Jacksonville, Tex., to Coeur d'Alene. The company will engage in the manufacture and wholesaling of western red cedar posts, poles and piling.

Kellogg Radio Apparatus Finding Ready Market

The Kellogg Switchboard & Supply Co. in turning a portion of the activities of its laboratories and testing and manufacturing organizations into production of radio equipment has proceeded slowly and carefully in order that the Kellogg brand would mean the same high quality that it indicates in telephone apparatus. Starting with a radio head set which is said to be one of the lightest and most efficient on the market, they have gradually designed and put on the market a line

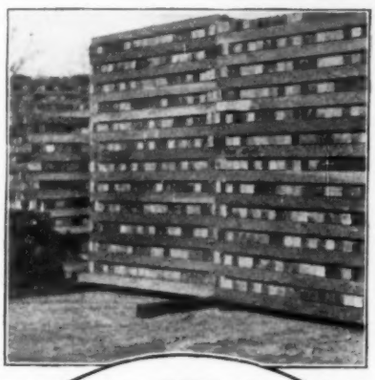
of variable condensers, variocouplers, variometers and other parts. An effort is now being made to bring up production so that there will be no delay in making deliveries.

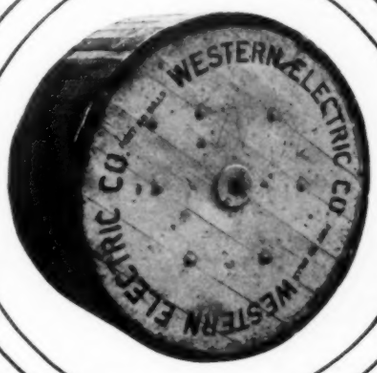
LINE WIRE DATA

Technical Data of Value to the Telephone Man Compiled by Copper-Clad

Rankin, Pa.—The Copper Clad Steel Co., of Rankin, has issued a number of technical data sheets some of which will be of interest to telephone men. R. J. Frank, assistant manager of sales, in a recent letter calls attention of telephone men to the fact that many do not distinguish between the various wire gauges.

It is taken for granted that No. 12 wire in solid copper and in Copperweld wire is the same diameter as No. 12 iron wire. Actually the diameter of a given number of copper or copperweld wire which is given in the American or B&S gauge is somewhat less than the diameter of the same number of iron wire which is given in the Birmingham wire gauge (BWG). In spite of the smaller diameter, how-





Everything for Outside Plants

is as near you as our nearest House

Poles
Western Red Cedar
Northern White Cedar
Chestnut
Creosoted Yellow Pine

Crossarms
Giant Rainier Fir
Yellow Pine

Wire and Strand
Iron and Steel

Cable
Western Electric Lead Covered Cable

And
Insulators
Pole Line Hardware
Anchors
Construction Tools
Hand Tools
Leather Goods
Batteries

A National Electrical Service

ADDRESS THE NEAREST OF OUR 48 HOUSES

Western Electric Company

OFFICES IN ALL PRINCIPAL CITIES

ever, the copper and Copperweld wires have better conductivity than iron wire of the same number but in a different gauge.

The comparison is clearly brought out in the data sheets. The speech transmission characteristics of iron and Copperweld wire are also given in the data sheets. The following table is of interest as showing the comparison:

Table of Speech Transmission Equivalents Showing Approximate Length of Copperweld and Galvanized Open Wire Lines Which Have Speech Transmission Equivalent to 32 Miles of No. 19 Standard Cable (Metallic).

Size Wire			Speech Transmission Equivalent 40%	
A.W.G. (B.&S.)	B.W.G.	Diam. (In.)	Conductivity Copperweld	E.B.B. Galvanized
..	8	.165	.....	145 Miles
6	..	.162	390 Miles	.....
..	10	.134	.....	125 Miles
8	..	.128	271 Miles	.....
9	..	.114	228 Miles	.....
..	12	.109	.....	100 Miles
10	..	.102	193 Miles	.....
12	..	.081	141 Miles	.....
14	..	.064	105 Miles	.....

(From report of F. F. Fowle.)

The speech transmission equivalents of 30% conductivity Copperweld wires are approximately three-fourths of those of 40% conductivity Copperweld wires of equal size.

The Copperclad Steel Company will gladly send copies of the Telephone Line Wire and Final Price Data Sheets to anyone who will write for them.

AUTOMATIC IN BOMBAY

Two Exchanges of 11,000 Lines Capacity to Be Installed in Near Future

Bombay, India.—Following the example set by the Post & Telegraph Administration of the Indian Government in installing Strowger automatic telephone equipment at Simla, Sahore, Poona, and Amritsar, and in view of the successful results obtained, the Bombay Telephone Co. has decided to adopt Strowger service, and shortly will proceed with the installation of equipment to serve a total of eleven thousand lines in the city of Bombay.

The contract for this equipment has been secured by Automatic Telephone Manufacturing Co., Ltd., in whose Liverpool factory the apparatus will be manufactured. It is anticipated that installation will be completed and the new system ready for the cut-over, early in 1924.

Bombay is particularly well adapted for the successful exploitation of the Strowger system, no less than sixty-two different languages and dialects being in common use among its population of approximately one million. The city is built on the southern end of Bombay Island, which is 11 miles long and 4 miles across at its widest point. The island communicates with the larger island of Salsette by means of road and rail bridges at its northern end.

Bombay is the great cotton market of western India; a large percentage of the population being employed in this industry.

From a climatic standpoint the adoption of Strowger automatics for the telephone users of Bombay is another endorsement of this system. The atmospheric conditions at Bombay are by no means ideal for telephony, the humidity being very high at some seasons of the year. Considerable experience in the operation of Strowger automatic telephone equipment under climatic conditions similar to those prevailing in Bombay has already been gained at Manila, Honolulu, Havana, and other humid centers of population, where the highly successful results obtained, under such exceptional conditions have resulted in repeat orders and periodical extensions of Strowger equipment.

The proposed total of 11,000 lines of Strowger equipment will be housed in two exchanges; one, the present "Central," accommodating immediate equipment for 6,500 lines and making provision for an ultimate capacity of 15,000. The other automatic exchange will replace a temporary manual telephone exchange which has just been completed at the northern end of the city and equipment will be provided there for immediate requirements on 4,500 lines with ultimate capacity of 15,000.

The 5 digit system will be adopted for Bombay and provision made for connecting to all long distance toll lines entering the city. The scheme embraces line switches of the latest rotary type, together with covered type selectors and connectors.

Considerable economies in floor space and cabling will be secured by the adoption of the "Unit" type intermediate distributing frame for the line circuits. Under this arrangement, cross connecting frames are mounted on top of the individual units, and, while affording exactly the same facilities, dispense with the necessity for a separate intermediate distributing frame.

Standard selector and repeater trunk boards will be installed, together with power equipment designed to carry the ultimate load, except for the batteries which, at the outset will only be fitted with sufficient plates to provide ampere hour capacity for immediate requirements.

BRIDGED CONDENSERS

Leich Finds a Way to Cut Down Radio Interference

Genoa, Ill.—After extensive experiments the Leich Electric Co. of Genoa, has devised a method whereby practically all of the interference between their frequency converter and radio receiving sets may be eliminated. The method consists of bridging two condensers, one between each outside terminal and center terminal of the left hand transformer.

While not all the interference is stopped it makes radio receiving practicable and by keeping the contact points clean at all times, the results are much better.

These condensers may be obtained from the Leich Electric Co. of Genoa, Ill., and this company will give any further information requested.

MORE NEWSPAPER ADS

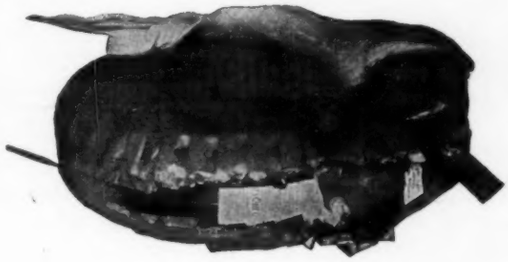
Oklahoma Utility Information Bureau Stresses Value of Paid Newspaper Publicity

Oklahoma City, Okla.—Since the establishment of the Oklahoma Bureau of Public Utility Information two years ago, there has been an increase of approximately 400% in the amount of advertising public utility companies are running in the daily newspapers of Oklahoma. How much of this increase has been due to the efforts of the Bureau of Public Utility Information, in repeatedly calling attention to the advisability of continuous advertising, it is impossible to say.

The gratifying feature of the situation, however, is that a number of public utility companies in this state have aligned themselves with the most progressive utility companies of other states by proper advertising of their business as a permanent policy.

Public utilities of the United States recently organized a Public Utility Advertising Section of the Associated Advertising Clubs of the World. Public utility information committee directors, at their recent meeting in Atlantic City, N. J., pledged themselves to assist this organization in advocating the idea of legitimate advertising by every public utility. These directors decided to align themselves with vigilance committees of advertising clubs in trying to eliminate freak advertising, such as advertising in circulars and programs, and participation in unusual and spectacular advertising schemes. The directors will urge all public utility managers and executives to follow the lead of the most progressive thought in the industry and in other business and make regular advertising appropriations and devote their money to legitimate and approved means of advertising.

TRADE SIMCORE MARK



Smooth finish
Easy to pull in
Safe and Satisfactory
Quick delivery

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST. BOSTON 9
CHICAGO SAN FRANCISCO

Dependable Since June 1st, 1904

RUNZEL-LENZ
ELECTRIC MFG. CO.

Specialists in Manufacture of:
Switchboard and Operators' Cords
Receiver and Desk Set Cords
Transmitter Cords
Radio and Wireless Receiver Cords

CABLES

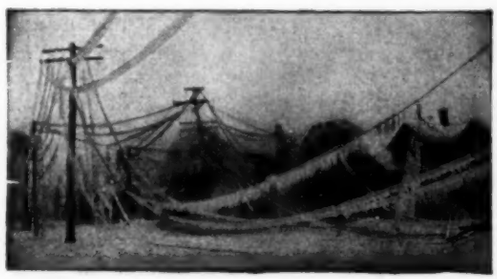
for Switchboard and Inter-Phone Systems—both Braided and Lead-Covered Types

WIRE

Interior Telephone Wire
Flame-Proof Jumper Wire
Switchboard Wire
Cotton Sleeving

CATALOG SENT ON REQUEST

Runzel-Lenz Electric Manufacturing Co.
1751-57 North Western Ave., CHICAGO



WHY TAKE THE RISK WHEN
"COPPERWELD"
TRADE MARK REG. U.S. PAT. OFF.
GIVES GREATER SAFETY AND
COSTS LESS PER MILE YEAR

LINE WIRE
TWISTED PAIR
GROUND RODS
DATA ON REQUEST

COPPER CLAD STEEL COMPANY
OFFICE AND WORKS: RANKIN, PA.
NEW YORK CITY OFFICE: 30 CHURCH ST.
WESTERN SALES REPRESENTATIVES:
STEEL SALES CORPORATION, CHICAGO, ILL.

"INDIANA"
TELEPHONE AND
TELEGRAPH WIRE

PROVEN BEST BY TEST

Time and the aid of America's foremost engineers, have enabled us to develop and manufacture the highest grade wire known to the trade. It is greatest in conductivity and lasting qualities, due to the superior quality of material from which it is made, as well as its *Extra Double Galvanizing*, which insures longest life.

STEEL STRAND

Single and Double Galvanized, Standard, Siemens-Martin, High Strength and Extra High Strength Grades.

HANDLED BY MOST JOBBERS

MANUFACTURED BY
INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

Everstick

The standard anchor of companies whose engineering practice is standard for the industry.

Telephone companies of every size are using EVERSTICK Anchors because they are the best value in the world for holding hard and fast and for ease of installation.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

Reduce Desk Set Breakage With COLYTT'S WALL BRACKET HOLDER

Look over your desk set repairs and you'll see a total that will suggest your immediate investigation of the Colytt Wall Bracket Holder.

It holds the phone secure and handy. Keeps the cord from kinking and moisture. Has a handy note pad, directory holder and nickel or slug container. It's made of steel in handsome dull black finish.

You can make a good profit on the installation of Colytt Wall Bracket Holders and cut down your maintenance expenses and complaints.

Here is a real service and profit aid to both the telephone company and its business and residence subscribers.

The price singly is $2.50. Big discounts in quantities.

Write us for complete details, and see that here's something you need.

THE COLYTT LABORATORIES
Engineering
Dept. 15, 565 W. Washington St., Chicago
Makers of the famous "Whispering Mouthpiece"

E. POCH & CO.
ROGERS, MICH.
White Cedar
POLES
20 ft. to 35 ft.
UNTREATED
DIRECT FROM PRODUCER TO PURCHASER
Get Poch prices

SHORTS

On the farms of Iowa there are 184,000 telephones; eighty-six per cent of the rural homes being equipped with telephone service.

* * *

New York City has 1,100,000 telephones, or one for every five persons.

* * *

The Bell system has under its control 14,000,000 telephones.

* * *

The New York Telephone Co. has 48,000 employes.

* * *

The Western Electric Co. produces more than 6,000 miles of cable annually for the New York Telephone Co. alone.

Attention, Climbers

A knot hole half way up the stick
A very little matter—
In goes your spur, and out it cuts
Gosh, how a man will spatter!

One did not watch his footing
As up the pole he rambled;
He, and the paving stones below,
Were very badly scrambled.

A crooked and poorly sharpened spur,
He thought not worth attention.
The undertaker's notice read,
"Home papers kindly mention."

A little, scarcely noticed crack
Allowed his spur to bend;
His relatives and friends were all
Invited to attend.

So keep your spurs both sharpened,
And watch your step as well.
They'll all say he's some climber
Not, I saw him when he fell.

—J. M. Weeks, line assigner, Rhode Island division, in Telephone Topics.

Safety Sam Says

"These birds we see goin' around tackin' signs on telephone poles must think the lineman ain't been havin' enough chances to get hurt."—Bell Telephone News.

Technical Reply

"Have you read 'If Winter Comes'-" asked Mrs. Dewhurst.

"No," replied Margaret, at Harrison. "Every time I go to the library for it they give me a 'busy' report."—Bell Telephone News.

Telephone Talks
No. 2

RECUPERATION
OF DRY CELLS

The busiest ingredient and perhaps the most valuable, in any dry cell, is the manganese dioxide. Its function is to bring about a recuperation in power after the dry cell is put in use.

Manganese dioxide of various grades give different results according to the capacity of the chemical to enter into reaction with the other materials in the cell. The chemical action is of a rather complicated nature and could not be covered within the confines of this column.

Briefly, the more expensive and pre-treated manganese makes all the difference in the world in producing effective recuperation in contrast to the less costly manganese.

VICTOR DRY CELLS

are made with an exclusive grade of manganese dioxide, from mines that serve as a source of supply to no other battery manufacturer.

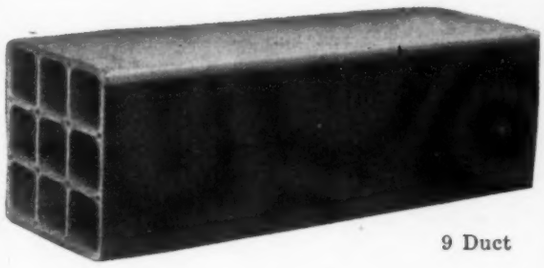
Furthermore, the manganese dioxide that goes into Victor Cells is specially treated at the factory.

The result is conclusive proof of the value of this manganese dioxide. Victors regain from 20% to 30% more strength after use than any cell on the market.

That's why, in addition to costing less per barrel, they cost less per day's service.

THE CARBON PRODUCTS CO.
Lancaster Ohio

MANUFACTURERS OF



9 Duct

VITRIFIED, GLAZED, CLAY CONDUIT

We carry large stocks of round singles, square single, two, three, four, six and nine duct, in standard and short lengths, splits, mitres and bends.

SERVICE and QUALITY
GUARANTEED

THE CLAY PRODUCTS CO.
BRAZIL, INDIANA

This
Waste
Receptacle

Reduces Your Plumbers' Bills and Maintains Sanitary Conditions.

Place them in the individual compartments of your Ladies' Toilets for the disposal of used Sanitary Napkins in place of flush bowl and floor.

Made of pressed steel, white enameled.

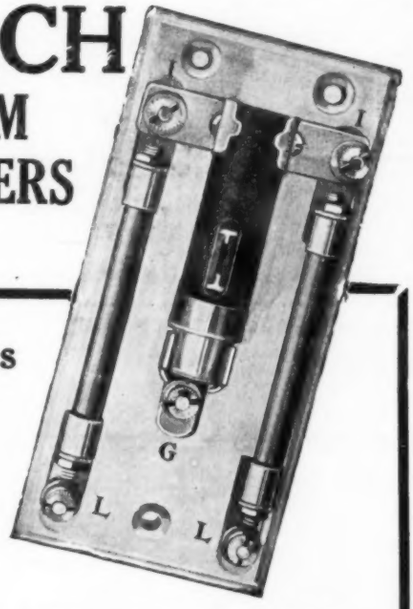
A necessity for all exchanges employing women. Hundreds in use by Pacific Telephone Co.

Price $2.00 each. Write for Quantity Prices.

First Aid Equipment & Supply Co.
350-353 I. W. Hellman Bldg. Los Angeles, Calif.

Sanitary Napkin Coin Control Vending Machines Our Specialty

BRACH
VACUUM
ARRESTERS



at prices within your reach

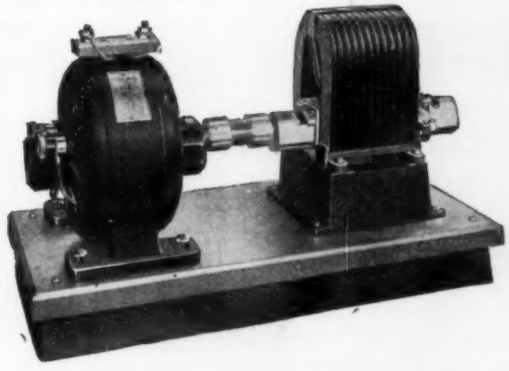
When the best protection costs no more, why not have it? BRACH arresters insure; non-grounding of lines, cables, clear transmission, balance of potential between pairs, and full protection against power crosses or lightning. There are no carbons to clean and no maintenance bills.

You can readily afford BRACH Vacuum Arresters at our present low prices. Type 440, shown above, complete with porcelain base, fuses and mountings, sells at $1.50 each.

L. S. BRACH MFG. CO.
NEWARK, N. J.

YOUR TELEPHONE RINGING
Will Not Interfere with
RADIO TRANSMISSION
If the Ringing Is Done by a
Holtzer-Cabot
Magneto-Ringing Motor-Generator

We are prepared to ship you one of these machines subject to a guarantee to this effect. It is non-interrupting, and the ringing is uniform under all conditions. Eventually you will install one—why delay giving your subscribers the BEST SERVICE?



The Holtzer-Cabot Electric Co.
Chicago Boston

New York Telephone Co. Tries Commission Rates

New telephone rates for New York State, fixed by the Public Service Commission's order of January 25, 1923, were put into effect by the company March 1st. J. S. McCulloh, Vice-President of the New York Telephone Co., does not believe the rates will produce sufficient revenue or even the amount estimated by the commission, but his company will give them a trial and if they prove inadequate, will ask for a readjustment. The changes affect more than 800,000 contracts for service. Reductions are made for business and residence service outside of New York City and for certain residence rates in the city. Certain rates for business and residence service in the metropolis are increased but the increases depend largely upon the message use of the subscribers, so the amount of additional revenue is problematical. The company does not agree with the commission's finding on the valuation of its property in New York State and the rate of return upon that valuation. The commission's valuation figure is about $246,000,000, although the United States Federal Court, last April, stated that any valuation found could not be much less than $300,000,000, and since then new facilities costing more than $50,000,000 have been added. Upon this stripped valuation, the commission would allow a return of only 7 per cent, although courts and previous commissions in New York and other states have fixed 8 per cent as a reasonable return for public utilities with hazards. The company reserves the right to take action regarding the valuation of its property and rate of return later.

Baltimore, Md.—The Chesapeake & Potomac Telephone Co. is reported to have perfected plans for the absorption of the South Dorchester and the Cecil Farmers' Telephone companies.

Charles W. McKay
and Associates
"A Balanced Consulting Service at Reasonable Cost"
646 NO. MICHIGAN AVENUE
CHICAGO
Telephone—Superior 6535

STEPHENS
CLIMBERS
Straps, Belts and Safetys
W. H. BUCKINGHAM
BINGHAMTON, N. Y.

Rebuilt and Good as New
Complete Line of Telephone Equipment Thoroughly Overhauled by Honest Experts In This Business, in Chicago, Over 18 Years.
Write for Latest List of Guaranteed Bargains.
Rebuilt Electrical Equipment Co.
1940-41 West 21st St. Chicago, Ill.

PEERLESS Automatic Water Stills
Absolutely pure water for less than one or two cents a gallon, no matter how polluted your supply of water may be. For drinking, chemical or battery purposes the Peerless stills give you the best, ample supply at lowest cost.
Operated without attention other than occasional cleaning.
Write for complete details
SPARTA MFG. CO.
111 S. Hill Street South Bend, Ind.

COFFEY'S
method of keeping your "General Books" in his office is economy and endorsed by Commissions.
Write for particulars.
COFFEY SYSTEM & AUDIT CO.
118 E. New York St., Indianapolis, Ind.

PATENT ATTORNEY—Inventors desiring patents should read the treatise, "How to Reduce Your Invention to a Property Right"; free, on request. Lester E. Barrett, Patent Lawyer, Drawer 830, Washington, D. C.

Ask Massachusetts to Slap Tax on Telephone Shares

Boston, Mass.—Henry F. Long, tax commissioner, has petitioned the state legislature to pass a bill which will place a tax on American Telephone Co. shares in this state. Dividends on the company stock have been exempt from the Massachusetts income tax. It is estimated that forty per cent of the $700,000,000 stock in the company is owned in Massachusetts. The effect of the proposed law would be that instead of yielding 7.37 per cent on the present price the stock would return, tax paid, only 6.93 per cent.

Cumberland's Taxes in Mississippi Growing Fast

Vicksburg, Miss.—Year by year the Mississippi tax assessment of the Cumberland Telephone & Telegraph Co. seem to be getting bigger and bigger. A summary of the growth is shown as follows:

Year	Tax
1918	$2,963,537
1919	3,007,269
1920	5,027,304
1921	5,696,780
1922	6,290,226

The growth started when the law took the assessing of the telephone company properties out of the hands of the railroad commission and put it in the hands of the state tax commission.

$37.50 Addressograph

CHEAPER than typewriter—SAVES 20% of YOUR present costs — 5 to 15 times FASTER and BETTER than pen or typewriter.
FREE TRIAL will prove it!
Easy Pay't. Terms
No. 780 3-23
909 W. Van Buren St., Chicago, Ill.

INVENTORS — Read the treatise, "How to Reduce Your Invention to a Property Right," free on request. Lester E. Barrett, Drawer 830, Washington, D. C.

DIAMOND EXPANSION BOLT Co
90 West St. ◇ New York
MANUFACTURERS
Expansion Bolts Drills
Screw Anchors Toggle Bolts
Cable Clamps Bridle Rings
Duct Rods Guy Clamps
GALVANIZING
PLANT - GARWOOD, N. J.
DISTRIBUTORS
Western Electric Company
INCORPORATED

Trade Mark

EVER - PROTECT CABLE COMPOUND
For underground cable without use of conduit. Eliminates corrosion and deterioration of cable sheath by chemical action. Prevents depredation by rats, and dampness from defective cable sheath or defective wiping of joints. Flexible, unaffected by heat or cold, lasting. Adheres readily to cable.
OUR LITERATURE WILL INTEREST YOU
The National Cable Compound Company, Inc.
Mitchell Indiana